THIRD AMERICAN EDITION.

OF

Nicholson's

BRITISH ENCYCLOPEDIA

or Dictionary of

ARTS & SCIENCES

illustrated by upwards of 180 elegant Engravings

PHILADELPHIA

Published by Mitchell, Ames & White

W. Brown Printer.

1819

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BRITISH ENCYCLOPEDIA,

OR

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OF

ARTS AND SCIENCES.

COMPRISING

AN ACCURATE AND POPULAR VIEW

OF THE PRESENT

IMPROVED STATE OF HUMAN KNOWLEDGE.

BY WILLIAM NICHOLSON,

Author and Proprietor of the Philosophical Journal, and various other Chemical, Philosophical, and Mathematical Works.

ILLUSTRATED WITH

UPWARDS OF 180 ELEGANT ENGRAVINGS.

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likely to allay the constitutional irritation. He must then wait until the operations of nature have separated the sloughs caused by the urine, endeavouring, however, to introduce an elastic catheter, where he should allow it to remain. Poultices, fomentations, and the warm bath, should be resorted to, if there are any appearances of inflammation; and abscesses, or accumulations of urine, should be opened early and freely.

Incontinence of urine. Sometimes this fluid dribbles away without any sensation of the patient. Here paralysis of the bladder is the cause, and may be induced in various ways, as from injuries of the spine, over distension of the organ, &c. In the latter case, the urine should be carefully drawn off at regular intervals; cold bathing, bark, blistering the sacrum or perineum, electricity, tincture of cantharides internally, &c. will be of service.

Sometimes the patient can hold his urine to a certain degree, when an irresistible propensity to evacuate it comes on. Here irritability of the bladder is the cause, and may be induced by bad piles, fistula in ano, &c. Opium, the warm bath, fomentations, diluting drinks, &c. may be resorted to when no obvious cause appears.

Imperforate vagina. Sometimes the labia have their opposed surfaces grown together, leaving perhaps merely a small opening, through which the urine is imperfectly discharged, but marked with a line, showing the proper distinction. This may be congenital, or the effect of disease. Sometimes a thin membrane closes both the meatus urinarius and vagina in newly born children. In both these cases the use of the knife is necessary; and lint should be interposed between the divided surfaces. There is another form of the same mal-formation, in which the vagina alone is closed; and no symptoms appear until puberty, when the menstrual discharge does not flow. The uterus swells, and at last a kind of labour pains comes on. Here the membrane must be divided to discharge the accumulated menses, and the edges of the cut kept asunder.

Imperforate anus. The part may either be closed by a membrane, or be too contracted to allow the feces to be evacuated. It may be rightly formed at its outer part, but terminate in a cul de sac; or there may be no vestige whatever of anus. In the first species, a division of the membrane is the remedy; and in the second, a dilatation of the contracted part by the crooked bistoury. If an obstruction should be discovered within the gut, it may be perforated with the trochar, introduced according to the course of the intestine. The latter species is attended with very little hope of saving life. The surgeon may cut in the situation of the anus, and follow his dissection along the sacrum, in order to find the end of the gut, which, when found, should be punctured.

Fistula in ano. Any formation of matter near the anus is very likely to terminate in this complaint; the suppuration extends in the fat and cellular substance round the rectum, and sinuses form, having small external apertures, and seldom healing without an operation. The commencement of the disorder may be a phlegmonous abscess, attended with considerable sympathetic fever; or it may have a more erysipelatous character, spreading more widely, being more superficial, and attended with depression of the powers of the constitution. The former is seen in young, strong, and healthy subjects; the latter in weakened, intemperate, and unhealthy constitutions. The parts in the neighbourhood of the disease are often affected; and hence retention of urine, strangury, prolapsus and tenesmus, piles, &c. are produced. The complaint sometimes begins in an induration of the skin near the anus without pain. This hardness gradually softens and suppurates. The matter may either point in the buttock, at a distance from the anus, or near this latter part, or in the perineum. It may escape from one opening, or from several. Sometimes there is not only an external aperture, but another internal one, communicating with the cavity of the intestine.

A soft poultice and fomentations are the best means of treating these abscesses; which, if they are phlegmonous, should not be opened until the skin has become thin; but, when they are of the erysipelatous kind, should be punctured immediately, to prevent any further extension of the malady. The general treatment must correspond with the nature of the constitutional disturbance. In all abscesses about the anus, the incision should comprehend all the skin covering the matter, as the cavity is then most likely to fill up from the bottom. The dressing should be small in quantity, light, and unirritating. If, however, the case passes into a fistula, it will be necessary to make it an open wound by cutting through the rectum from the end of the

hollow to the anus. A probe having been introduced at the external opening of the fistula, serves as a director for the probe-pointed knife, which will be felt in the rectum by the surgeon's left fore finger. If the fistula should not have penetrated the gut, the bistoury should be pushed through its side. The probe may now be withdrawn, and the operation completed by bringing the knife out with its point applied to the finger which was in the intestine; and thus all between the edge of the knife and the anus must be divided. A soft piece of lint should now be placed in the wound, and remain until it is loosened by suppuration, and all the future dressings should be mild and unirritating. The callosities, of which surgeons have complained so much in these cases, arise from injudicious treatment, and particularly from the use of caustic and stimulating applications.

Prolapsus ani. The internal coat of the gut may be protruded through the sphincter; or a portion of the intestine with all its coats may descend. Causes which weaken the sphincter, and such as force the intestine downwards, contribute to this affection. Costiveness, tenesmus kept up by hemorrhoids, ascarides, fistula in ano, stone, &c. are of this kind. The cause should be removed when that is practicable. The gut must be replaced, but previously clysters, fomentations and poultices, or leeches, and cold washes, are necessary. Horizontal posture, and avoiding costiveness, are very important points. A compress and bandage may be necessary to retain the replaced gut; and astringent clysters have been advised. If the protruded part has become indurated, thickened, and painful, and will not admit of reduction, it may be extirpated. Sometimes an introsusception, commencing at the cæcum, has protruded at the anus. This case is quite beyond the powers of art.

Prolapsus, inversio, and *retroversio uteri,* are considered under the article MIDWIFERY.

LITHOTOMY.

The existence of a stone in the bladder causes various symptoms in the bladder itself, and others in neighbouring parts. The former are frequent inclination to void the urine, which sometimes stops suddenly from the stone mechanically obstructing its passage; pain in making water, and particularly after the discharge, from the bladder contracting on the foreign body; mucus, and sometimes blood in the urine, and pain on exercise. The latter are an uneasiness and itching at the end of the penis, leading the person to draw and elongate the prepuce; sense of weight in the perineum; tenesmus; numbness of the thighs, &c. These symptoms come on in fits. In order to ascertain the fact, a solid steel instrument, shaped like a catheter, and called a sound, is introduced into the bladder, where its point, meeting the stone, gives decided information to the surgeon. It must be moved in various directions after its introduction, as it may not immediately or easily come in contact with the stone. The operation should never be performed, unless the stone can be plainly felt before the operation: the rectum should be previously emptied, but it is more advantageous for the bladder to be full. The patient is to be placed with his pelvis at the edge of a table, and the staff introduced into the bladder. The thighs and legs are then bent so as to enable him to grasp the soles of the feet with his hands, and the limbs are retained in this position by broad garters, doubled and placed by means of a noose round the wrists, carried over the back of the hand, and inside of the foot; then brought up again, and continued round the wrist and ankle, and firmly tied. The staff is shaped like a sound or catheter, and has a groove for conducting a cutting instrument into the bladder. An assistant standing on the patient's right side holds the handle of the staff with one hand, making its convexity project in the perineum, and draws aside the scrotum with the other. An incision should be made through the integuments, commencing on the left side of the raphe of the perineum, just opposite to the membranous part of the urethra, and continued obliquely downwards and outwards for about three inches between the anus and ischium. The transversalis perinei should then be cut through, and the membranous part of the urethra freely opened, so as to expose the groove of the staff. The beak of the gorget is now introduced into the groove, and the operator takes the handle of the staff into his left hand, holding the gorget in his right. He then thrusts the gorget into the bladder, keeping its beak in close contact with the groove of the staff, and bringing the handle of the latter instrument downwards and forwards, in order to raise its point, and make its direction coincide with the axis of the bladder. The cutting edge of the gorget, by this mode of introduction, divides the prostate gland and neck

of the bladder. This instrument is used of various figures by different surgeons. The best perhaps is that in which the cutting edge of the instrument extends horizontally from its beak, from which it may be carried to the length of three quarters of an inch. A good anatomist may perform the operation with a scalpel, which instrument will enable him to divide the parts with more exactness. The escape of the urine shows that the bladder is opened. The staff should now be withdrawn, and a proper pair of forceps passed along the concave surface of the gorget into the bladder, for the purpose of seizing and extracting the stone. This instrument is first employed as a probe to ascertain the position of the stone, which being accomplished, the blades are to be expanded, and moved in such a direction as to grasp it; and the instrument, very firmly held, may then be slowly withdrawn, being moved from side to side, in order to bring the foreign body through the wound. If the stone be very large, it may be expedient to dilate the wound with a curved knife, or to break the stone in the bladder, by means of forceps constructed for that purpose. In the latter case, and in instances where the stone is broken in the operation of extracting it, the bladder should be washed out with lukewarm water, to remove any small fragments. Careful examination with the finger is necessary, to ascertain that nothing is left behind. A compress of lint, pledget, and T bandage, may be put on, but they are of little service, as the urine escapes through the wound. Since peritoneal inflammation is the occurrence most to be feared after lithotomy, great attention to the state of the abdomen is required, and on the least indication of such a consequence, venesection, leeches, warm bath, warm fomentations, blisters, emollient clysters, and purgatives, should be resorted to, according to the symptoms.

This mode of performing lithotomy is called the lateral operation; it has been performed with an instrument called a lithotome caché, instead of the gorget. This is a long narrow knife, concealed in a grooved instrument, which is passed into the bladder along the groove of the staff exposed in the way already described. A spring being then compressed, makes the knife rise out of the groove, and the instrument is withdrawn in this state, cutting the prostate and bladder as it recedes. In former times an opening has been made into the bladder above the pubes, particularly in young subjects; this was called the high operation, but has long been disused.

Spina bifida is a swelling situated on the spine of infants at the time of birth. It consists of a sac, filled with an aqueous fluid, and composed of the integuments and the membranous sheath of the spinal marrow, protruding through a fissure caused by a deficiency in the bones. The subjects are generally weak; diarrhœa, paralytic state of the lower limbs, and inability to retain the urine and feces, often attend. The tumour enlarges, inflames, and ulcerates, and then the patient dies; but this occurrence takes place at different periods. No treatment has hitherto been of any service.

Caries of the vertebræ. This is a disease of the spine, generally attended with a degree of curvature, and with a paralytic state of the lower limbs. It is most frequent in children, but not peculiar to them. The affection of the limbs is first observed. There is an unwillingness to move about, and the patient often trips and stumbles. The legs involuntarily cross each other. The power of directing the feet to any exact point is then lost, and the natural sensibility of the legs and thighs becomes much impaired. At this time there is usually a more or less marked bending of the spine forwards, occasioning an angular projection of the spinous processes. The general health becomes much affected, and the urine and feces are discharged involuntarily. The cause of all these complaints is the diseased state of the vertebræ, which are softened, and more or less absorbed, affecting the inclosed medulla spinalis. In the progress of the disorder the bodies of three or four vertebræ may be entirely destroyed, so as to lay bare the front of spinal marrow. We are indebted to Mr. Pott for proposing the only treatment that has ever afforded relief in this affection, *viz.* that of making an issue on each side of the diseased portion of the spine. This can be best accomplished with the calx cum kali puro. Several pieces of sticking plaster are to be stuck together, and a hole should then be cut in the mass, corresponding to the size of the intended issue. This is applied on the back, and a thin layer of the caustic placed in the hole, and covered by another piece of plaster. In four or five hours the plaster should be removed, and a poultice applied until the eschar separates. The issue is then filled with peas or beans, confined by adhesive plaster, over which pressure should be made, by firmly binding on a

piece of sheet lead. The issues must be kept open until the complaints have entirely disappeared.

AMPUTATION.

In whatever part this is performed, the surgeon's object is the same, *viz.* to save enough of the surrounding soft parts to cover the extremity of the bone, and enough of skin to cover the whole. The stump is always treated as a wound which should be united by the first intention; its sides are therefore brought together, and retained in apposition by straps of adhesive plaster, and appropriate bandages. By this, which is the improved method of modern surgery, introduced by Mr. Alanson of Liverpool, the wound made by removing a thigh is often agglutinated in forty-eight hours, and the patient consequently escapes the dreadful pain and irritation, and vehement sympathetic affection of the constitution, which almost invariably attended the old practice of dressing the stump with dry lint as an open wound, and consequently healing by means of granulation and cicatrization, instead of adhesion.

In *amputation of the thigh*, surgeons used to cut at once down to the bone, and saw that through; but in order to save more soft parts, and thereby to avoid the projection of the bone, which commonly attended that method, the double incision was devised; by which the skin and muscles are divided separately. More difficulty is experienced here than in any other amputation, in saving muscles enough to cover the bone, which, in this particular instance, is especially desirable, from the the pressure which the end of the stump must experience in supporting the weight of the body. The sound leg should be tied to the table, and the tourniquet applied on the inside of the thigh. The limb should be cut off as near to the knee as possible. A circular incision should then be made by the surgeon, standing on the outside of the limb, through the skin and adipous substance. The integuments should be drawn upwards by an assistant, and any cellular connection that prevents their retraction should be divided. A cut should now be carried through the loose muscles, at the part to which the skin has been withdrawn, and when they have retracted, those which are fixed to the bone should be divided at the point to which the former had retracted. The latter may be separated from the surface of the bone, for a short distance, by a common scalpel, to allow of the bone being sawed higher up than it could be otherwise. This part of the operation should follow, the surface of the wound being kept out of the way of the saw, by means of a retractor, which is a piece of linen somewhat broader than the stump, torn at one end, in its middle part, to the extent of about eight or ten inches. It is applied by placing the exposed part of the bone in the slit, and drawing the ends of the linen upward on each side of the stump. Besides defending the surface of the wound from the teeth of the saw, the retractor will undoubtedly enable the operator to saw the bone higher up than he otherwise could do. The femoral artery should be drawn out by means of a pair of forceps, and tied separately; other large arteries should also be secured, without including any of the surrounding soft parts. Smaller branches must be taken up with the tenaculum. It is necessary to slacken the tourniquet, in order to discover the vessels. The wound should then be thoroughly cleansed from all coagulated blood, by means of a soft sponge and water, and one end of each ligature removed. The skin and muscles are now to be placed over the bone, in such a direction that the wound shall appear only as a line across the face of the stump, with the angles at each side, from which the ligatures should be brought out. The skin is supported by long strips of adhesive plaster, applied at right angles to the line of union of the wound; the ligatures are guarded by lint spread with spermaceti-cerate; and a linen roller is carried round from above downwards, two cross pieces having first been put over the end of the stump. The dressings should not be moved for four days.

In *amputating the leg*, the bones should be sawn through, about four inches below the patela. The tourniquet is applied in the lower part of the thigh. After cutting through the skin, which should be drawn upwards, it must be reflected from the flat surface of the tibia, and front of the leg, so as to cover those parts which could not be covered by any large muscle. The calf is then to be cut through, by an oblique incision slanting upwards; the rest of the muscles, and the interosseous ligament, should be divided by a double-edged knife, called a catlin, and the bones sawn, after the previous application of a double tailed retractor.

In *amputating the arm*, or *fore-arm*, we should preserve as great a length of the limb as the case will allow.

Amputation of the shoulder-joint has been done in various ways. An incision should be carried through the skin and deltoid muscle down to the bone, from the front of the joint, a little below the clavicle, obliquely downwards and outwards. The deltoid should then be turned up so as to expose the head of the bone, which must be brought entirely into view, by dividing the orbicular ligament all round. One cut of an amputating knife will then separate the limb. The axillary artery should be immediately tied. This vessel must be firmly compressed, by an assistant, above the clavicles, during the whole of the operation.

The *fingers* and *toes* should be removed at their joints. Make a circular incision through the skin, about one third of an inch below the articulation; draw the integuments up, and cut through one lateral ligament of the joint, which you can then dislocate. The remaining connections are easily divided. Bring the skin together over the end of the bone. If you amputate at the first joint, make two cuts, one at the back, and the other towards the front; these must meet when the bone is removed. It is sometimes necessary to tie the arteries.

Paronychia, or *whitlow*, is an abscess occurring about the nails, or still more deeply under the soft parts of the fingers. In the latter case, swelling of the arm, inflammation of the lymphatics, and considerable constitutional disturbance, frequently attend. The complaint is always very painful, attended with great throbbing; and often terminating in the loss of the nail. We should, if possible, prevent suppuration, by the employment of local antiphlogistic means. If these do not succeed, a soft poultice may be used, and the collection should be opened as soon as possible.

Venesection. When a vein is to be opened in any part of the body, pressure must be made on the vessel, between the place where the puncture is to be made and the heart. This prevents the return of blood through the vessel, makes it swell, and become conspicuous. As the supply of blood is still continued through the arteries, the vein bleeds freely when it is opened; but care must be taken, particularly in the arm, not to apply the ligature so tightly as to stop the pulse. The bandage should be placed a little above the elbow, and the most prominent and conspicuous vein may be opened; excepting that if equally convenient, one would avoid the vessel lying over the brachial artery. The vein may be fixed by placing the thumb of the left hand a little below the place where it is designed to introduce the lancet. That instrument should be pushed obliquely into the vein, and when its point is a little within the cavity, the opening may be rendered sufficiently large by carrying the front edge forward and upward, so as to bring it out of the part. In many cases, where we wish to make a sudden impression on the vascular system, we make the opening longer than usual, that the blood may be withdrawn more suddenly, and cause fainting. The stream may be accelerated, by putting the muscles of the fore-arm into action. It stops when the ligature is removed, or, at least, if the surgeon press with his left thumb below the vein. The sides of the incision should be placed in contact, and maintained in that condition by a small compress of linen, bound on with the bleeding fillet applied in the form of the figure of eight. In opening the external jugular vein, the pressure must be made with the surgeon's finger; and the compress should be fastened by means of sticking plaster. The temporal artery may be opened by a simple puncture; and the bleeding may always be stopped by a compress fastened by means of sticking plaster. The operation of bleeding may be followed by various unpleasant consequences; as ecchymosis round the vein, inflammation of the integuments, absorbents, fascia, or vein itself. The former symptom generally disappears of itself in a week or ten days; the others may be treated according to the general principles of surgical practice.

PARTICULAR FRACTURES.

We shall say a few words on the most common and important kinds of fracture.

Fracture of the lower jaw may be detected by introducing a finger into the mouth and pressing on the front portion of the bone, while the fingers of the other hand are applied on the outside to the back of the bone. Alternate pressure in these situations occasions a very distinguishable crepitus. When the broken ends are adapted to each other, some wetted pasteboard is to be applied along the outer surface and base of the bone; and over this a bandage, with four tails, should be placed. The centre of this bandage is applied to the chin, the two posterior tails tied together at the top of the head, and the other two more posteriorly. The wet pasteboard adapts itself to the figure of the part, and constitutes, when dry, a splint exactly accommodated to the form

of the jaw. All motion of the broken bone should be avoided: hence talking, chewing, &c. are improper; hence, too, the food should be soft, and introduced by a spoon.

The *fracture of the clavicle* is attended with a displacement of the bone; its scapular portion being drawn downwards and forwards. In order to restore it, let the shoulder be drawn backwards, and the arm raised; then the surgeon should place the fracture in as even a position as he can, cover it with a piece of soap plaster, and keep the shoulder back by means of the figure of eight bandage; the fore-arm and elbow being well supported by a string. A leather apparatus lacing behind, and having straps to pass in front of the shoulders, similar to the instruments used for girls with the view of keeping the shoulders back, is a more effectual mode of accomplishing the object.

It is often difficult to detect *fracture of the ribs*. By placing the fingers where pain is felt, or where the blow was received, a crepitus can be distinguished in many cases, on making the patient cough; yet, if the matter be doubtful, the safest plan is to treat the patient as if his ribs were broken. It will be readily seen how emphysema, extravasation of blood, &c. may occur when the bone is displaced inwardly. Our object is to keep the broken ends motionless. Hence, after a piece of soap plaster has been applied externally on the situation of the fracture, a broad roller should be put firmly round the chest, or we may apply an apparatus made expressly for the purpose, consisting of a broad girth, with three or four buckles and straps, which may be tightened at pleasure. Bleeding is proper, unless particular circumstances contraindicate it.

In *fractures of the os brachii*, after restoring the limb to its natural figure, and putting on a piece of soap plaster, apply a splint, lined with a pad of soft materials, from the acromion to the external condyle, and another from the margin of the axilla to the internal condyle. Some add two others, one before and one behind. They must all be carefully fastened with tapes, and the fore-arm and hand should be well supported by a sling. There is always a distinguishable crepitus in fractures of the fore-arm. After a piece of soap plaster has been applied, two splints must be employed; one is to be placed along the inside, and the other along the outside, of the fore-arm. The limb is to be in the mid state, between pronation and supination; and the inner splint should reach far enough into the hand to support it, and prevent it from falling into the prone state.

In *fractures of the olecranon* the elbow must be placed straight, to approximate as much as possible the broken ends, and the limb must be continued in that position until the patient has recovered.

When the *os femoris* is broken, there is severe local pain, an incapacity to move the limb, a distinguishable crepitus on motion, and deformity of the part from retraction of the lower portion. The latter appearance will occur more readily, in proportion as the fracture is more oblique; and it arises entirely from the action of the muscles which are fixed in the bone below the fracture, together with the flexors of the knee. Besides the shortening of the limb, produced by the retraction of the lower portion of the fractured bone, there is another deformity arising from its being rotated outwards; an effect produced by most of the large muscles of the thigh. The higher the fracture, the more difficult is it to prevent displacement. When the neck of the thigh bone is broken, there is severe pain in the groin, much aggravated by motion of the part. The extremity is shortened, the limb turned out, and the trochanter higher than usual towards the pelvis. Yet the limb may be drawn down to its natural length, in doing which a crepitus is sometimes perceived. In order to relax as much as possible the muscles which tend to displace the broken bone, a bent position of the thigh and leg was recommended by Mr. Pott. He recommended that the patient should lie on the side of the fracture, with the thigh bent on the pelvis, and the knee half bent. A broad splint well padded should be placed under the thigh, from above the trochanter to below the knee, and another should extend from the groin below the knee on the opposite surface. Narrower splints should occupy the intervals between those on the inside and outside of the thigh. The splints should be fastened as firmly as they can be borne, by means of leathern straps. A patient with a broken os femoris should by no means be placed on a soft bed, as the trunk of the body depresses it into a hollow, and by sliding downwards increases the displacement.

Fracture of the patella is generally caused by violent exertion of the muscles, whose tendons are inserted into this bone, and not by direct violence. The upper end of the bone is drawn upwards by the

muscles, and a total inability to extend the leg is generally observed. The muscles should be relaxed, by extending the knee, and bending the thigh on the pelvis: they may also be surrounded with a roller, a compress being placed just above the upper portion of the broken bone. The newly-formed substance which unites the broken ends is of a ligamentous or cartilaginous nature, and not bony.

Fractures of the leg. If they affect both bones, there can be no doubt of the nature of the case; but the symptoms are more uncertain, when the fibula alone is broken. The limb should be laid on its outside, with the knee moderately bent. Japanned iron, or wooden splints shaped to the part, and covered with soft pads, are employed. The leg having been placed in the above mentioned position, extension is made, if necessary; and the under splint, covered with its pad, and having an eighteen-tailed bandage laid on it, is passed under the limb. Having observed that the ends of the bones are in exact contact, the surgeon places his soap plaster over the fractured portion, and lays down the bandage. Another soft pad is then put over the upper surface of the leg, and the other splint applied. The leather straps attached to the splints are fastened with sufficient tightness, to prevent any motion of the fractured part. When the pressure of the splints is painful, soft pads are necessary.

Ruptured tendo Achillis. The large tendon of the muscles of the calf of the leg is sometimes torn asunder by the violent exertion of those muscles. An inability to extend the ankle, and a consequent impaired power of progression, follows. The ends of the tendon may be approximated by straightening the ankle and bending the knee. The foot may be kept in this position by the assistance of bandages. The case requires about the same degree of confinement as a fracture. Some persons have not kept their bed for this accident, but have walked about with a high-heeled shoe. The tendon of the plantaris muscle is sometimes ruptured, and the accident is attended with the symptoms as if the tendo Achillis were torn.

PARTICULAR DISLOCATIONS.

Lower jaw. This bone can only be luxated forwards, when the condyloid processes advance beyond the eminentiæ articulares. In this case the mouth remains open, and cannot be shut; there is pain; impaired and almost destroyed articulation and deglutition, &c. One or both condyles may be displaced. To reduce it, the thumbs, well covered, should be introduced as far backward as possible along the grinding teeth. The surgeon then elevates the front of the bone with his fingers, and the palms of his hands, while he depresses the condyles with his thumbs; and the latter prominences are thus forced back into the glenoid cavities of the temporal bones.

Dislocations of the head and vertebræ are probably imaginary occurrences, as we know hitherto of no well-attested example of their occurrence.

The *os humeri* is probably luxated more frequently than any other bone. It may be displaced downwards, forwards, and backwards. In all these cases a vacancy is distinguishable under the acromion, in consequence of the absence of the head of the humerus from the glenoid cavity of the scapula. The head of the bone forms a preternatural tumour in some situations. The elbow cannot be carried close to the chest, nor can the limb be elevated, without extreme pain, to a line with the acromion. Great pain is caused by the pressure of the head of the bone in its unnatural position, particularly when it lies in the axilla. Our object is to dislodge the head of the os brachii from its unnatural situation, in order to bring it on a level with the glenoid cavity of the scapula. To accomplish this purpose, extension must be made; that is, the limb must be drawn forcibly outwards; and the bone itself should be made to operate as a lever, which can be best effected by the surgeon's knee placed under it towards the head, while he depresses the elbow at the proper time, so as to raise the head towards the glenoid cavity. The patient's body should be fixed, by placing a broad towel round the chest, and tying it to some immoveable point. The extension should be gradual, and kept up unremittingly, which can be best effected by means of pullies. The elbow should be bent, and the extending power applied just above the condyles of the humerus. When the surgeon finds that the head of the bone is drawn out of its unnatural position, he may allow the extension to be remitted, and depress the elbow. The arm should afterwards be kept quietly in a sling, a piece of soap plaster, and a spica bandage, being applied to the shoulder.

Elbow. Dislocations at this joint are

very difficult to discover, from the swelling, which comes on so quickly. The radius may be displaced forwards; and here the flexion of the elbow is almost entirely destroyed. The ulna may at the same time be driven backwards: it may also be pushed inwards, so as to occupy the place of the radius. All these are easily reduced, when they are ascertained. Leeches and cold washes should be employed afterwards.

Wrist. The distortion consequent on a displacement of the carpus is so considerable, that the nature of the case is rendered immediately obvious. The reduction is easy; and after it has been accomplished, the hand and fore-arm should be bound on a splint, and supported by a sling.

Thigh. The os femoris may be displaced downwards and inwards, so that the head rests on the obturator foramen; upwards and outwards, when the head is towards the sacro-ischiatic foramen, and the trochanter forwards; and upwards and forwards, so that the head rests upon the os pubis. In the first case, the toes are turned out, and the limb elongated. In the second, the limb is shortened, the foot turned inwards, and the buttock more prominent. Great pain is excited by attempting to move the limb in all cases of luxation, and a vacuity is discernible in the natural situation of the head of the bone. The patient should be placed on the side opposite to the accident, and his pelvis should be fixed by means of a sheet passed under the perineum. Extension may be made by fixing a broad towel, or the pullies, just above the condyles. When the head of the bone is on the dorsum ilii, the extension is to be continued until it has been brought to the acetabulum, into which the surgeon must guide it. In the dislocation on the obturator foramen, we should make a lever of the bone, by passing a towel under the thigh, near the trochanter, and elevating it after a slight extension has been made, the condyles being at the same time depressed.

The *patella* may be dislocated either inwards or outwards. Its reduction is very easy, when the muscles inserted into it have been relaxed.

The *knee* hardly admits of complete luxation, without such injury of the parts as would render the loss of the limb necessary. The nature of the accident must be obvious from the altered figure of the parts, and replacement is perfectly easy. Inflammation must be guarded against afterwards.

The *ankle* may be dislocated outwards, the fibulæ being at the same time broken. This is generally a compound luxation; the extremity of the tibia, when displaced from the astragulus, very often penetrating the integuments. Formerly this accident was considered as a cause of amputation; and many practitioners have been in the habit of sawing off the projecting portion. Yet by replacing the bone, closing the wound, keeping the parts quiet, &c. the injury has been often recovered. Luxation may also occur in the opposite direction, and forwards. The latter is very difficult to retain in place, as the muscles of the calf are so apt to move the foot.

SURIANA, in botany, so named in honour of Joseph Donat Surian, a genus of the Decandria Pentagynia class and order. Natural order of Succulentæ. Rosaceæ, Jussieu. Essential character: calyx five-leaved; petals five; styles inserted into the inner side of the germs; seeds five, naked. There is but one species, *viz.* S. maritima, a native of the sea coast of South America, and the islands of the West Indies.

SURRENDER, in law, a deed or instrument, testifying that the particular tenant of lands or tenements for life, or years, doth sufficiently consent and agree, that he which has the next or immediate remainder, or reversion thereof, shall also have the present estate of the same in possession; and that he yields and gives up the same unto him; for every surrenderer ought forthwith to give possession of the things surrendered. Where a surrender is made in consequence of a fresh lease, and that lease turns out invalid, the surrender is considered as not valid, and the former lease is established. Surrender into the hands of the lord is the mode of passing copyholds, and a surrender to the use of a will is necessary, in order to pass them by a will.

SURROGATE, one who is substituted or appointed in the room of another; as the bishop or chancellor's surrogate.

SURSOLID, in arithmetic and algebra, the fifth power, or fourth multiplication of any number or quantity, considered as a root. See ROOT.

SURSOLID *problem*, in mathematics, is that which cannot be resolved but by curves of a higher nature than a conic section, *v. gr.* in order to describe a regular endecagon, or figure of eleven sides in a circle, it is required to describe an isosceles triangle on a right

line given, whose angles, at the base, shall be quintuple to that at the vertex; which may easily be done by the intersection of a quadratrix, or any other curve of the second kind.

SURVEYING. This important art, however difficult its attainment may appear, is nevertheless to be comprised within a very few general rules. The accuracy of the work must depend entirely on the correctness of the instruments employed, the steadiness of the hand and eye of the operator, and the faithfully tracing the given lines and angles on the paper designed to exhibit the estate, or premises, under examination. The following leading principles will give an insight into the mode of displaying the results, whatever may be the means employed for their computation. First. We are to reject the actual curvature of our globe, in all land surveys; that is, where no current of water, or the level of any fluid, is under consideration: such curvature amounts to about eight inches in every mile, either of latitude or of longitude. In brief, we consider the earth to be flat, instead of spherical. Secondly. We must ever carry in mind, that every triangle is equal to half a parallelogram of equal base and altitude; as shown under the head of GEOMETRY. Thirdly. That wherever there is a deviation from the horizontal, there will be a greater extent of surface displayed on a scite than if the same were horizontal. To illustrate this, let an orange be cut through in the middle, and the flat part, *i. e.* the section, be placed on a level table: it is evident that the round surface of the half orange will offer more surface than the flat section which lays upon the table: but, if it were required to build on the semi-spherical surface, it would be found that no more houses, &c. could be raised thereon, than would stand on the extent of the flat section. The reason of which is, that no more perpendiculars can be raised on one than on the other. This shows how fallacious is the mode of purchasing what is called side-long, or hanging, land by the acre. The greater the deviation from the horizontal, the more is the base diminished. Fourthly. The surveyor must recollect, that all planes, of whatever extent or form, may be divided into, and be represented by, triangles of various forms and dimensions, whose aggregate will amount to the measurement of the area thus partitioned off: for, as Euclid justly observes, "All the parts, taken together, are equal to the whole." It will be further seen, that every figure may, either directly or circuitously, be commuted into a triangle, of corresponding area: but it may be necessary, at the same time, to observe, that the squaring of the circle has not hitherto been perfected; though we have arrived so nearly to the completion of that object, as to leave no room for regret at the want of absolute precision.

These points being completely understood, the learner may proceed to the rudiments of surveying; supposing him to be grounded in the few preliminary problems which enable him to describe the ordinary figures: should he not have obtained any previous information on that subject, we recommend that he turn back to the heads of GEOMETRY and MATHEMATICAL *instruments;* under which he will find various items indispensable towards his progress.

We shall submit a few propositions which the student may work with his compasses, plain scale, and protractor: when able to do all that may be needful on paper, he may then try his hand with one or other of the various instruments in use among surveyors.

Proposition I. "To ascertain the contents of the square field ABCD, fig. 1. Plate XV. Miscel." Here little is to be done; one of the sides being measured, say 70 yards, and multiplied by itself, will give 4,900 square yards for the area; or one acre (*i. e.* 4,800 square yards) and 100 square yards.

Proposition II. "To survey the field ABCD, fig. 2." This figure having the sides AB and CD parallel, and at right angles to AD, add the lengths of those parallels, say 70 and 90 yards, together; divide half their sum (*i. e.* 80) and multiply that half by the depth of AD, say 70; which being multiplied by the medium length, GF, gives an area of 5,600 square yards. The parallelogram, ABED, might have been computed by simply multiplying its length by its breadth; and the triangle, BCE, might be taken separately, thus: the depth, (or altitude) BE, 70 yards, to be multiplied by half CE, (*i. e.* 10 yards) this would give 700; and the produce of AB, which is 70, by BE, which is also 70, would be 4,900; making in all 5,600, as above shown.

Proposition III. "To survey the inclined parallelogram ABCD, fig. 3." It is to be observed that, in all inclined figures, the altitude is ascertained by a perpendicular from the base, as at C, to the parallel of that base, as at E, on the line

Proposition XI. "To carry a line of sight or a level, in the direction of AB, over the rising ground C." Ascertain where the line of sight strikes the hill at *e*; carry the instrument to that point, and, in the exact direction of the former sight, take a second sight from *e* to *a*, or to any convenient spot, where a pole and target should be fixed. See LEVELS. As this survey for a canal is to be taken by means of a spint level, the exact altitude of each sight must be taken, by noting the height of the target from the plain, AB, at every sight, or by following up a regular succession of levels, each of which will be the height of the instrument above the last. Thus the hill will be ascended: the descent on the other side is effected by the inversion of the foregoing mode; always taking the descending levels of the target for canals; but for roads, or for laying down a meridional line, when once the summit is gained, a long sight may be taken to a distant object: this subject is pleasingly exemplified in a new work published by Longman and Co. entitled "Mathematics simplified, and practically illustrated," in which a great variety of instructive and useful matter will be found, together with a description of a new instrument, on a very simple construction, said to be equal to every branch of surveying.

SUS, the *hog*, in natural history, a genus of Mammalia, of the order of Belluæ. Generic character: four front teeth in the upper jaw, converging; six in the lower, projecting; two tusks in the upper jaw, short; two in the lower, standing out; snout truncate, prominent, and moveable: feet cloven. These animals are allied by their teeth to the carnivorous quadrupeds, and by their cloven feet to the ruminating ones. They feed almost indifferently upon animal and vegetable substances, devouring with avidity what is most nauseous and disgusting. They use their snout for digging up the ground in quest of roots, are fond of rolling and wallowing in mud, and are distinguished by extreme fecundity. There are six species, of which the following are the most important:

S. scrofa, the common hog. All the varieties of this animal originate in the wild boar, which is found in most of the temperate regions of Europe and Asia. It is smaller than the domesticated animal, and uniformly of a dark grey colour, approaching to black. It is armed with formidable tusks, sometimes ten inches, or even more, in length; those in the under jaw curving inwards, and capable, from their size, strength, and sharpness, of inflicting the most dreadful wounds. Before these animals attain their third year they are gregarious, and, when danger is at hand, particularly, they muster in numerious parties, and with great promptitude, at the signal of alarm. Uniting thus, they present so formidable an array, as speedily to disperse the enemy, few creatures, or none, daring to commence an attack against such a combination of strength and valour as they exhibit. When the wild boar is complete in growth, he depends upon his solitary exertions for his protection, is seldom seen in society, ranging the forests alone; rarely commencing an attack, as his food consists almost solely of roots and vegetables, but repelling one with all the fiercenes of courage, and all the resentment of retaliation.

These animals are often hunted by dogs, particularly of the mastiff breed. After many pauses in their progress, in which they turn round, and defy their enemies to the attack, which, however, is generally declined, they at length refuse to proceed, and halt for the grand and final conflict; in which, though eventually overpowered by the number of dogs, and the spears of the hunters, they defend themselves with the most astonishing intrepidity, perseverance, and energy; and, regarding their case as absolutely desperate, determine, at least, not to die unrevenged. See Mammalia, Plate XXI. fig. 1.

The common hog has smaller tusks and larger ears than the wild boar, and is generally of a dull, or dirty, yellowish-white. It is clumsy in its shape, filthy in its manners, and gross and ravenous in its food, devouring almost every variety of rejected animal or vegetable substance, and distinguished by the quantity nearly as much as by the rankness of its food. The offal of the kitchen, garden, and barn, furnishes it with an exquisite banquet. It was rejected as unclean both by the founders of the Jewish and Mahometan religion, as unfit for human sustenance, for which, it is, nevertheless, most admirably adapted, and of incalculable value. The sailors of the British navy are in a great degree supported by the flesh of that animal, which Moses and Mahomet decided to be unfit for the food of man; and in most countries of Europe, it is an important and indispensable article of the food of the inhabitants. The hog is possessed of an acute smell, and is

highly agitated during the violent blowing of certain winds, uttering the most dreadful screams, and exhibiting the highest restlessness, apprehension, and turbulence. It is fattened to an extraordinary size, and has been known to attain the almost incredible weight of 1215 pounds. It produces two litters in the year, and in each from ten to twenty young ones. The male must be kept at a distance from these, as it will otherwise destroy and devour them, and the female herself has often acted this unnatural part, and is particularly apt to do it, if observed attentively, during the crisis of parturition. The hog was unknown in America when that quarter of the world was discovered by the Spaniards, but now abounds in every part of it. The Chinese breed is most valued in England. There is an accidental variety of the domestic hog with undivided hoofs.

S. Ethiopicus, or the Ethiopian hog, is very similar to the last. It is fierce and formidable in the highest degree, and burrows in the ground, in deep recesses, which it prepares with both its hoofs and nose. It is particularly distinguished by a large lobe, or wattle, beneath each eye.

S. baby-roussa is remarkable for the form and situation of the upper tusks, which are placed externally, and turn upwards in a curve towards the forehead. It abounds in the Indian islands, lives solely on vegetables, and rests itself, in sleep, by hooking its upper tusks round the branch of a tree. It can swim with rapidity, and is valued for food.

S. sajassu, or the Mexican hog, or pecari, is the only animal of the genus native of America, where it is gregarious, fierce and dangerous, and is occasionally seen in herds of several hundreds. It feeds on fruits and roots, and also on serpents, lizards, and toads; and will attack and devour the rattlesnake, we are told, without the slightest injury. It is less than the common hog, has bristles nearly resembling the prickles of an hedge-hog, and is also distinguished by an orifice on its back, from which perpetually issues a most fetid watery humour. The pecari will skin snakes by means of its teeth and feet, before it devours them, with great dexterity. The common hog is reported, on good authority, to attack and eat the rattle-snake with the same impunity as the pecari. For the baby-roussa, see Mammalia, Plate XX. fig. 2.

SUSPENSION, or *Points of Suspension*, in mechanics, are those points in the axis or beam of a balance, wherein the weights are applied, or from which they are suspended.

Suspension *of arms*, in war, a short truce agreed on by both armies, in order to bury the dead, wait for fresh instructions, or the like.

Suspension, in rhetoric, is the carrying on a period or discourse, in such a manner as to keep the reader in expectation of something considerable in the conclusion. But great care must be taken that the reader's expectation be not disappointed; for nothing is more contemptible than to promise much and perform little; or to usher in an errant trifle with the formality of preface and solemn preparation.

SWABBER, an inferior officer on board ships of war, whose employment it is to see that the decks are kept neat and clean.

SWARTZIA, in botany, so named in honour of Olof Swartz, M. D., a genus of the Polyadelphia Polyandria class and order. Essential character: calyx four leaved; petals single, lateral, flat; legume one-celled, bivalve; seeds arillated. There are six species.

SWEDENBORGIANS, a religious society, who have been so called from Emanuel Swedenborg, in whose theological works are taught the doctrines which they receive. He was born at Stockholm in Sweden, Jan. 29, A. D. 1689; and died in London, the 29th March, A. D. 1772. His father was Jesper Swedberg, bishop of West Gothia, and president of the Swedish church in Pennsylvania and London. In the year 1716, at the age of 28, he was associated by Charles XII. with the celebrated Polhamman, called the Swedish Archimedes, to assist him in the direction of buildings and mechanical works, and without solicitation appointed extraordinary assessor to the Royal College of the Mines, the King having given him the choice either of this office, or that of professor in the Royal Academy of Upsal. "An universal knowledge in the belles letters (says Monsieur Sandel, in his eulogium delivered in the name of the Academy of Sciences at Stockholm) and a remarkable degree of learning, had at that time, made his name known both within and without the kingdom." "You may find in him at once, (says the same gentleman) a happy assemblage of an excellent memory, a prompt conception, and a most clear judgment, united to a desire that was never cloyed, and the

strongest inclination of an assiduous study after acquirements of the most certain kind in philosophy, in almost all kinds of mathematics, natural history, physics, chemistry, anatomy, and finally theology, without enlarging on the Eastern and European languages, in which he was very well versed." In 1718, at the siege of Fredericksall, he executed a work of the greatest importance. By cutting through the mountains, and raising the vallies for two miles and an half from Stromstad to Idef-jol, which separates Sweden from Norway, he caused two gallies, five large boats, and a sloop to be sent there; by which Charles XII. was enabled to have all the great artillery for the siege carried to Fredericksall. In 1719, he was ennobled by Queen Ulrica Eleonora, and named Swedenborg, and took his seat with the nobles of the equestrian order. His various works in philosophy, the belles lettres, mathematics, mechanics, natural history, physics, chemistry, and anatomy, amount to 24 articles, one of which, his Opera Philosophica and Mineralia, published, part at Leipsic and part at Dresden in 1734, comprehend three folio volumes. Prior to the publication of this work, the Academic Consistory and the Society of Sciences at Upsal had requested him to solicit the place of professor of the sublime and abstracted mathematics, which had been filled by Nils Celsius. This he however declined. He was enrolled a member of the Society of Sciences at Upsal, of the Academy of Sciences at Stockholm, and of the Academy of St. Petersburg. His works furnish the editors of the *Acta Eruditorum*, published at Leipsick, with many articles, and the whole of his Treatise on Iron, and the preparations of steel, was inserted by the authors of the Description of Arts and Trades at Paris, in their collection of the *best things* written on those subjects.

Nearly all his works are written in the Latin language. After occupying himself until the age of 53, in the investigation of philosophical and natural subjects, he dedicated himself wholly to spiritual things. In his letter to the King of Sweden, he says, "I have already informed your majesty, and beseech you to recall it to mind, that the Lord our Saviour manifested himself to me in a sensible personal appearance; that he has commanded me to write what has been already done, and what I have still to do: that he was afterwards graciously pleased to endow me with the privilege of conversing with angels and spirits, and to be in fellowship with them." "When my writings are read with attention, and cool reflection, (in which many things are to be met with as hitherto unknown), it is easy enough to conclude, that I could not come by such knowledge, but by a real vision, and converse with those in the spiritual world." "If any doubt shall still remain, I am ready to testify, *with the most solemn oath* that can be offered in this matter, that I have said nothing but essential and real truth, without any mixture of deception. This knowledge is given to me from our Saviour, not for any particular merit of mine, but for the great concern of all christians' salvation and happiness; and as such, how can any venture to assert it is false?" From the year 1744, he continued to write, and from 1747, to publish his theological works in the Latin language. These, if collected in an uniform edition, would perhaps fill in the English language 30 octavo volumes of 500 pages. His two most extensive works are his Arcana Cælestia, in 12 octavo volumes, in which he explains, verse by verse, every word in the books of Genesis and Exodus, according to what he calls the spiritual sense; and his Apocolypsis Explicata, (published since his decease), in 6 octavo volumes, wherein he treats of the book of Revelations in the same manner. The doctrines exhibited in his writings are to the following purpose:

1. Contrary to Unitarians, who deny, and to Trinitarians, who hold, a trinity of persons in the godhead, the Swedenborgians maintain that there is a divine trinity in the person of Jesus Christ, consisting of Father, Son, and Holy Ghost, just like the human trinity in every individual man, of soul, body, and operation; and as the latter trinity constitutes one man, so the former constitutes one Jehovah God, who is at once the Creator, Redeemer, and Regenerator.

2. That Jehovah God himself came down from heaven, and assumed human nature, for the purpose of removing hell from man, of restoring the heavens to order, and preparing the way for a new church upon earth; and that herein consists the true nature of redemption, which was effected solely by the omnipotence of the Lord's divine humanity. But Swedenborg declares, that this divine humanity is from the Father, and is in itself like unto its divinity, and not like the humanity of another man; for, "with the Lord, the former forms, which were

from the maternal principle, were altogether destroyed and extirpated, and divine forms received in their place; for the divine love doth not agree with any but a divine form; all other forms it absolutely casts out; hence it is, that the Lord, when glorified, was no longer the Son of Mary."

3. They hold the notion of pardon obtained by a vicarious sacrifice, or atonement, as a fundamental and fatal error; but that repentance is the foundation of the church in man; that it consists in a man's abstaining from all evils, because they are sins against God, &c.; that it is productive of regeneration, which is not an instantaneous, but a gradual work, effected by the Lord alone, through charity and faith, during man's co-operation.

4. That man has free-will in spiritual things, whereby he may join himself by reciprocation with the Lord.

5. That the imputation of the merits and righteousness of Christ is a thing as absurd and impossible, as it would be to impute to any man the works of creation: for the merits and righteousness of Christ consist in redemption, which is as much the work of a divine and omnipotent Being, as creation itself. They maintain, however, that the imputation, which really takes place, is an imputation of good and evil; and that this is according to a man's life.

6. That the doctrine of predestination and justification by faith alone is a mere human invention, and not to be found in the word of God.

7. That the two sacraments of baptism and the holy supper are essential institutions in the New Church, the genuine and rational uses of which are now discovered, together with the spiritual sense of the holy word.

8. That the sacred scripture contains a threefold sense, namely, celestial, spiritual, and natural, which are united by correspondences; and that in each sense it is divine truth, accommodated, respectively to the angels of the three heavens, and also to men on earth.

9. The Word is inspired, not only as to all the particular expressions, but also as to all the particular small letters which compose every expression, and thus as to the smallest dot and tittle, and inwardly in itself, has stored up the arcana of heaven, which do not appear in the letter, when set in each of those things, which the Lord himself spake when he was in the world, and which he before spake by the prophets; there are things celestial, and altogether divine, and elevated from the sense of the letter; and this not only in each of the expressions, but also in each of the syllables of the expressions, and in each of the apexes of every syllable. Hence the books of the word have an internal sense, and are the following: the five books of Moses, Joshua, Judges, Samuel, one and two, Kings, one and two, the Psalms, the Prophets, Isaiah, Jeremiah, Lamentations, Ezekiel, Daniel, Hosea, Joel, Amos, Obadiah, Jonah, Micah, Nahum, Habakkuk, Zephaniah, Haggai, Zechariah, and Malachi; and in the New Testament, the four Evangelists, Matthew, Mark, Luke, and John, and the Revelations.

10. That in the spiritual world there is a sun distinct from that of the natural world, the essence of which is pure love from Jehovah God, who is in the midst thereof; that the heat also proceeding from that sun is, in its essence, love; and the light thence proceeding is, in its essence, wisdom; and by the instrumentality of that sun, all things were created, and continue to subsist, both in the spiritual and in the natural world.

11. They maintain, that there is not in the universal heaven a single angel, that was created so at the first, nor a single devil in all hell that had been created an angel of light, and was afterwards cast out of heaven; but that all both in heaven and hell are of the human race; in heaven such as had lived in the world in heavenly love and faith, and in hell such as lived in hellish love and faith.

12. That the material body never rises again; but that man, immediately after his departure from this life, rises again as to his spiritual or substantial body, (which was inclosed in his material body, and formed for his predominant love, whether it be good or evil,) wherein he continues to live as a man in a perfect human form, in all respects as before, save only the gross material body, which he puts off by death, and which is of no further use.

13. That the state and condition of man after death is according to his past life in this world; and the predominant love, which he takes with him into the spiritual world, continues with him for ever, and can never be changed to all eternity; but if evil, he abides in hell to all eternity.

14. That true conjugal love, which can only subsist between one husband and one wife, is a primary characteristic of the new church, being grounded in the marriage of goodness and truth, and cor-

responding with the marriage of the Lord and his church; and therefore it is more celestial, spiritual, holy, pure, and clean, than any other love in angels or men.

15. That the science of correspondences, (which has been lost for some thousands of years, but is now revived in the Theological Works of the Honourable Emanuel Swedenborg,) is the only key to the spiritual or internal sense of the holy word, every page of which is written by correspondences, that is, by such things in the natural world as correspond with and signify things in the spiritual world.

16. That all those passages in the scriptures, generally supposed to signify the destruction of the world by fire, &c. commonly called the last judgment, must be understood according to the above science, which teaches, that by the end of the world is not meant the destruction of it, but the destruction or end of the present Christian church, both among Roman Catholics and Protestants of every description, and that this last judgment took place in the spiritual world in the year 1757.

17. That the second advent of the Lord, which is a coming, not in person, but in the spiritual or internal sense of his holy word, has already commenced; that it is effected by means of his servant Emanuel Swedenborg, before whom he hath manifested himself in person, and whom he hath filled with his spirit, to teach the doctrines of the new church by the word from him; and that this is what is meant in the Revelation by the new heaven and the new earth, and the new Jerusalem thence descending.

These doctrines, to say the least of them, are ingenious. Many persons, indeed, of great respectability, and not a few men of learning and talent, even of the present day, believe that these doctrines are something more than ingenious. It is, however, not a little extraordinary, that, although the Swedenborgians openly deny the commonly received doctrine of a trinity of persons in the God-head, and believe, as they certainly do, that to assert that doctrine is nothing less than tritheism; and when it is also considered that the system of the highly-illuminated baron has excluded that other orthodox doctrine of a vicarious sacrifice by the death of Christ, we say, under these considerations, it is not a little to be wondered at, that there should be found any persons still in communion with our established church, who profess themselves members of the New Jerusalem church, as revealed by Emanuel Swedenborg. But the wonder increases much, upon the consideration, that some, even of the regular clergy of the English Church, are to be found among the disciples of the honourable baron! The present venerable and respectable minister of St. John's, Manchester, the Reverend Mr. Clowes, is not only an open professor of the faith of the New Church, but is also the well-known translator of all the baron's theological publications! The forbearing temper of many of our present ecclesiastical governors, and the liberal spirit of the times, are circumstances not a little honourable to the national character in general, and to our national clergy in particular. May this spirit and this forbearance continue to increase, until no discrepancy of mere opinion whatever, while unaccompanied by errors of conduct, or depravity of heart, shall be made the foundation of hatred, or the pretext for exclusive civil and religious privileges!

SWERTIA, in botany, so named in hohour of Eman. Sweert, a genus of the Pentandria Digynia class and order. Natural order of Rotaceæ. Gentianæ, Jussieu. Essential character: corolla wheel-shaped; nectariferous pores at the base of the segments of the corolla; capsule one-celled, two-valved. There are six species.

SWIETENIA, in botany, *mahogany-tree*, so named, in honour of the illustrious Gerard, L. B. a Swieten, archiater to Maria Teresa, Empress of Germany, a genus of the Decandria Monogynia class and order. Natural order of Trihilatæ. Meliæ, Jussieu. Essential character: calyx five-cleft; petals five, nectary cylindric, bearing the anthers at the mouth; capsules five-celled, woody, opening at the base; seeds imbricate, winged. There are three species. The S. mahogani, mahogany tree, is very lofty, and spreading with a wide handsome head; leaves reclining, alternate, shining, eight inches long, numerous on the younger branches; leaflets mostly in four pairs, quite entire, acuminate, bent in backwards, petioled, opposite, an inch and half long; recemes sub-corymbed, with about eight flowers in each, axillary, solitary, two inches long; flowers small, whitish. The mahogany tree is a native of the warmest parts of America, and grows plentifully in the islands of Cuba, Jamaica, and Hispaniola; in these islands the tree grows to a very large size, so as to cut into planks of six feet breadth: those on the

Bahama Islands are not so large; these, however, are frequently four feet in diameter, and rising to a great height, notwithstanding they are generally found on the solid rock, where there seems to be scarcely any earth for their nourishment. The wood brought from the Bahama Islands has usually passed under the name of Madeira wood; this the Spaniards make great use of for building ships; it is better adapted to this purpose than most sorts of wood yet known, being very durable, resisting gun shots, and burying the shot without splintering. The excellency of this wood for all domestic purposes, has been long known in England.

SWIMMING, the art, or act, of sustaining the body in water, and of moving therein; in which action the air-bladder and fins of fishes bear a considerable part. Some have supposed, that the motion of fish in the water depends principally upon the pectoral fins, but the contrary is easily proved by experiment; for if the pectoral fins of a fish are cut off, and it be again put into the water, it will be found to move forward or sideways, upward or downward, as well as it did when it had them on. If a fish be carefully observed, while swimming in a basin of clear water, it will be found not to keep these pectoral fins constantly expanded, but only to open them at such times as it would stop or change its course; this seeming to be their principal, if not their only use. The pectoral and ventral fins, in the common fishes of a compressed form, serve in the same manner in keeping the fish still, and serve in scarce any other motion than that towards the bottom; so that this motion of the fish, which has been generally attributed to their fins, is almost wholly owing to their muscles, and the equipoise of their air-bladder. That the use of the pectoral and ventral fins is to keep the fish steady and upright in the water, is evident from the consequences of their loss: if they are cut off, and the fish put again into the water, it cannot continue in its natural erect posture, but staggers about, and rolls from side to side. The fins of the back and anus are also of great use to the keeping the creature in its natural position, as is easily seen by cutting them off, and observing the motions of the fish afterwards. Though a great deal depends on the motion of the muscles of the several parts of the body, in the swimming of the fish, yet the tail, and those muscles which move the lower part of the body, to which it is affixed, are the great instruments by which their swift motions in the water are performed. The moving the tail, and that part of the body to which it adheres, backward and forward, or sideways any one way, throws the whole body of the fish strongly the contrary way; and even in swimming strait forward, the motion and direction are both greatly assisted by the vibrations of this part, as may be experienced in the motion of a boat, which, when impelled forward, may be firmly guided by means of an oar held out at its stern, and moved in the water as occasion directs. The dorsal muscles, and those of the lower part of the body, between the anus and tail, are the principal that are used in the motion of this part, and these are therefore the most useful to the fish in swimming. The muscles of the belly seem to have their principal use in the contracting the belly and the air-bladder. They have been supposed of use to move the belly-fins; but there are too many of them for such a purpose, and these fins have each its peculiar muscle, fully sufficient to the business. The use of the tail in swimming is easily seen, by cutting it off, and committing the fish to the water without it, in which case it is a most helpless creature.

Brutes swim naturally, but men attain this art by practice and industry: it consists principally in striking alternately with the hands and feet; which, like oars, row a person forward: he must keep his body a little oblique, that he may the more easily erect his head, and keep his mouth above water.

We shall here insert some maxims on the art of swimming that may be useful, and which are said to have been written by the late Dr. Franklin.

1. That though the legs, arms, and head of a human body, being solid parts, are specifically something heavier than fresh water, yet the trunk, particularlythe upper part, from its hollowness, is so much lighter than water, as that the whole of the body, taken together, is too light to sink wholly under water, but some part will remain above, until the lungs become filled with water; which happens from drawing water into them instead of air, when a person, in the fright, attempts breathing, while the mouth and nostrils are under water. 2. That the legs and arms are specifically lighter than salt water, and will be supported by it, so that a human body would not sink in salt water, though the lungs were filled as

above, but from the greater specific gravity of the head. 3. That therefore a person throwing himself on his back in salt water, and extending his arms, may easily lie so as to keep his mouth and nostrils free for breathing; and, by a small motion of his hands, may prevent turning, if he should perceive any tendency to it. 4. That in fresh water, if a man throws himself on his back, near the surface, he cannot long continue in that situation, but by proper action of his hands on the water. If he uses no such action, the legs and lower part of the body will gradually sink till he comes into an upright position, in which he will continue suspended, the hollow of the breast keeping the head uppermost. 5. But if in this erect position, the head is kept upright above the shoulders, as when we stand on the ground, the immersion will, by the weight of that part of the head that is out of water, reach above the mouth and nostrils, perhaps a little above the eyes, so that a man cannot long remain suspended in water with his head in that position. 6. The body continuing suspended as before, and upright, if the head be leaned quite back, so that the face looks upwards, all the back part of the head being then under water, and its weight consequently in a great measure supported by it, the face will remain above water quite free for breathing, will rise an inch higher every inspiration, and sink as much every expiration, but never so low as that the water may come over the mouth. 7. If therefore a person, unacquainted with swimming, and falling accidentally into the water, could have presence of mind sufficient to avoid struggling and plunging, and to let the body take this natural position, he might continue long safe from drowning, till perhaps help would come. For as to the clothes, their additional weight while immersed is very inconsiderable, the water supporting it; though when he comes out of the water, he would find them very heavy indeed. The subject has within the last two or three years been investigated in Nicholson's Philosophical Journal, whence it should seem, that if a person could have sufficient presence of mind never to raise his hands above water, he could not sink.

SWIVEL, in gunnery, a small piece of artillery carrying a shot of half a pound weight, and fixed in a socket on the top of a ship's side, stern, or bow, and also in the tops; the trunnions of this piece are contained in a sort of iron crotch, the lower end of which terminates in a cylindrical pivot, resting in the socket so as to support the weight of the cannon. By means of this swivel, which gives name to the piece of artillery, and an iron handle, the gun may be directed by hand to any object.

SWORD, an offensive weapon, worn at the side, and serving either to cut or stab. Its parts are the handle, guard, and blade; to which may be added the bow, scabbard, pummel, &c. Fencing masters, however, divide the sword into the upper, middle, and lower part; or the fort, middle, and foible.

SYENA, in botany, a genus of the Triandria Monogynia class and order. Essential character: calyx three-leaved; petals three; anthers oblong; capsule one-celled, three-valved. There is only one species, *viz.* S. fluviatilis. This is a minute mossy plant; stem somewhat branched, decumbent; leaves capillaceous, in whorls; flowers axillary, white, peduncled, solitary. It is a native of Guiana, in rivulets.

SYLLABLE, in grammar, a part of a word, consisting of one or more letters, pronounced together.

According as words contain one, two, three, four, &c. syllables, they are denominated monosyllables, bissylables, trisyllables, tetrasyllables, polysyllables, &c. and the division of a word, into its constituent syllables, is called spelling.

SYLLABUS, in matters of literature, denotes a table of contents, or an index of the chief heads of a book or discourse.

SYLLOGISM, in logic, an argument or term of reasoning, consisting of three propositions; the two first of which are called premises, and the last the conclusion. Syllogisms are nothing but the expressions of our reasonings, reduced to form and method: and hence, as every act of reasoning implies three several judgments, so every syllogism must include three distinct propositions. Thus, in the following syllogism:

Every creature possessed of reason and liberty is accountable for his action.
Man is a creature possessed of reason and liberty:
Therefore man is accountable for his actions.

We may observe that there are three several propositions, expressing the three judgments implied in the act of reasoning: the two first propositions answer the two previous judgments in reasoning, and are hence called premises; as being placed before the other, which is termed the conclusion. We are also to remember, that the terms expressing the two ideas whose relation we inquire after, as here, "man"

and " accountableness," are in general called the extremes; and that the intermediate idea, by means of which the agreement or disagreement of the two extremities is traced, *viz.* " a creature possessed of reason and liberty," takes the name of the middle term. Hence, by the premises of a syllogism, we are always to understand the two propositions, where the middle term is severally compared to the two extremes; for these constitute the the previous judgments, whence the truth we are in quest of, is by reasoning deduced. The conclusion is, that other proposition, in which the extremes themselves are joined or separated, agreeably to what appears upon the above comparison. As, therefore, the conclusion is made up of the extreme terms of the syllogism; so that extreme, which serves as the predicate of the conclusion, goes by the name of the major term; and the other term, or subject of the conclusion, is called the minor term. From this distinction of the extremes arises also a distinction between the premises; that proposition, which compares the greater extreme with the middle term being called the major proposition; and the other, where the lesser extreme is compared with the middle term, being called the minor proposition. In a single act of reasoning, the premises of the syllogism must be self-evident truths, otherwise the conclusion could not follow. For instance, in the major of the above mentioned syllogism, *viz.* " every creature possessed of reason and liberty is accountable for his actions," if the connection between the subject and predicate could not be perceived by a bare attention to the ideas themselves, the proposition would require a proof itself; in which case, a new middle term must be sought for, and a new syllogism formed to prove the said major: and should it so happen, that in this second essay there was still some proposition, whose truth did not appear at first sight, recourse must be had to a third syllogism to prove it. And when, by conducting our thoughts in this manner, we at last arrive at some syllogism, where the premises or previous propositions are intuitive, or self-evident truths, the mind then rests in full security, as perceiving that the several conclusions it has passed through, stand upon the immoveable foundation of self-evidence, and when traced to their source, terminate in it. The great art lies, in so adjusting our syllogisms to one another, that the propositions severally made use of as premises, may be manifest consequences of what goes before, so as to form one connected demonstration.

With respect to the different forms or figures of syllogisms, it frequently happens that the middle term is the subject of the major term, and the predicate of the minor; but though this disposition of the middle term be the most natural and obvious, it is not, however, necessary; since the middle term is often the subject of both the premises, or the predicate in both; and sometimes it is the predicate in the major, and the subject in the minor proposition. Now this variety in the order and disposition of the middle term, constitutes what logicians call the forms or figures of syllogism.

But besides this distinction of syllogisms into different figures, there is also a further subdivision of them in every figure, called modes, or moods. See Mood.

These distinctions of syllogism, according to figure and mood, respect chiefly simple syllogisms, or those limited to three propositions, all simple; and where the extremes and middle term are connected immediately together. But as the mind is not tied down to any one form of reasoning, but sometimes makes use of more, sometimes of fewer premises, and often takes in compound and conditional propositions, there hence arises other distinctions of syllogisms.

When in any syllogism the major is a conditional proposition, the syllogism itself is termed conditional. Such is the following one:

> If there is a God, he ought to be worshipped;
> But there is a God:
> Therefore he ought to be worshipped.

In syllogisms of this kind, the relation between the antecedent, or the conditional part, " if there is a God," and the consequent, " he ought to be worshipped," must ever be real and true; that is, the antecedent must always contain some certain and genuine condition, which necessarily implies the consequent; otherwise the proposition itself will be false, and therefore ought not to be admitted into our reasonings. There are two kinds of conditional syllogisms, one of which is called in the schools *modus ponens*; because from the admission of the antecedent they argue to the admission of the consequent, as in the syllogism above: the other is called *modus tollens*, because in it both antecedent and consequent are rejected, as in the following syllogism:

If God were not a being of infinite goodness, neither would he consult the happiness of his creatures;
But God does consult the happiness of his creatures;
Therefore he is a being of infinite goodness.

Again, as from the major's being a conditional proposition, we obtain conditional syllogisms; so, where it is a disjunctive proposition, the syllogism is also called disjunctive, as in the following example:

The world is either self-existent, or the work of some finite, or some infinite being.
But it is not self-existent, nor the work of a finite being:
Therefore it is the work of an infinite being.

Now a disjunctive proposition is that, where, of several predicates, we affirm one necessarily to belong to the subject, to the exclusion of all the rest, but leave that particular one undetermined; hence it follows, that as soon as we determine the particular predicate, all the rest are to be of course rejected; or if we reject all the predicates but one, that one necessarily takes place. When, therefore, in a disjunctive syllogism, the several predicates are enumerated in the major, if the minor establishes any one of these predicates, the conclusion ought to remove all the rest; or if, in the minor, all the predicates but one are removed, the conclusion must necessarily establish that one.

In the several kinds of syllogisms hitherto mentioned, we may observe, that the parts are complete; that is, the three propositions of which they consist are expressed in form. But it often happens, that some one of these premises is not only an evident truth, but also familiar, and in the mouths of all men; in which case it is usually omitted, whereby we have an imperfect syllogism, that seems to be made up of only two propositions: such is the following one:

Every man is mortal;

Therefore every king is mortal.

Here the minor proposition, "every king is man," is omitted, as being so clear and evident, that the reader may easily supply it.

SYLVAN, in mineralogy, a genus which is divided into four species; *viz.* 1. "The native sylvan," of which the colour is intermediate between tin white and silver white: it occurs massive and disseminated, and also in various kinds of crystals: internally it is shining, and its lustre is metallic: its specific gravity is from 4.1 to 6.1. Its constituent parts are,

Sylvan	92.55
Iron	7.20
Gold	0.25
	100

Before the blow-pipe it melts as easily as lead, emits a thick white smoke, and burns with a light green colour, and a sharp disagreeable odour. When exposed to a low heat, it is converted into an oxide: by an increase of temperature, it melts into a brownish black glass, in which gold grains are interspersed: at a still higher heat, the oxide is completely volatilized. It occurs in veins, and is accompanied with iron pyrites, blende lead-glance, quartz, and lithomarge, and is found in Transylvania. It bears a strong resemblance to antimony, and was formerly called "aurum problematicum:"—"white gold ore," &c. It was denominated "sylvan" by Kirwan, and is so called by Jameson, who thinks it more expressive than "tellurium," a name proposed by Klaproth.

2. "Graphic ore," which is likewise found in Transylvania: it is worked as an ore of gold, and has obtained the name of graphic gold: it consists of

Sylvan	60
Gold	30
Silver	10
	100

It occcurs, in veins, in clay porphyry, accompanied with iron pyrites, grey copper ore, blende, and sometimes, though rarely, with native gold. Before the blowpipe it burns with a green flame, and is volatilized.

3. "Yellow sylvan ore," which is white inclining to yellow, and is found disseminated and crystallized. Specific gravity 10.6. It dissolves in nitrous acid, and during the solution nitrous gas is evolved: the constituent parts are,

Sylvan	44.75
Gold	26.75
Lead	19.5
Silver	8.5
Sulphur	0.5
	100.

This is found in Transylvania, and is worked on account of the proportions of the silver and gold.

4. "Black sylvan ore," which is of an iron black colour, and occurs massive, and in small, thin, and longish six-sided tables: externally it is splendent, with a metallic lustre: and within it is shining: specific gravity is almost 9. Its constituent parts are,

Sylvan	18.8
Lead	24.8
Gold	4.15
Silver	0.25
Copper	0.6
Sulphur	1.4
Oxide of manganese	9.2
Quartz	43.7
	100.

It is found in Transylvania: it melts before the blow-pipe: the sulphur and sylvan are soon volatilized, and a blackish brown globule remains, which being melted with borax, a sort of silvery gold grain appears. It dissolves with effervescence in acids, and the nitro-muriatic acid extracts the gold from it.

SYMPHONIA, in botany, a genus of the Monodelphia Pentandria class and order. Essential character: one styled; corolla globular; berry five-celled. There is only one species, *viz.* S. globulifera, a native of Surinam.

SYMPHYTUM, in botany, *comfrey*, a genus of the Pentandria Monogynia class and order. Natural order of Asperifoliæ. Borragineæ, Jussieu. Essential character; corolla tubular, ventricose; throat closed by lanceolate rays. There are three species. We shall notice the S. officinale, common comfrey: this plant has a perennial fleshy root, externally black; stem two or three feet high, upright, leafy, winged, branched at the top, clothed with short, bristly hairs, which point downward; leaves waved, pointed, veiny, rough; the radical leaves on footstalks, broader than the rest; clusters of flowers, in pairs, on a common foot-stalk, with an odd flower between them; corolla yellowish white, sometimes purple; the rays downy at each edge. It is a native of Europe and Siberia; it is frequent in watery places, on the banks of rivers and ditches; flowering from the end of May to September.

SYMPLOCOS, in botany, a genus of the Polyadelphia Polyandria class and order. Natural order of Guaiacanæ, Jussieu. Essential character: calyx five-cleft; corolla five-petalled, erect at the base; stamens in four rows, growing to the tube of the corolla; fruit five-celled. There are four species.

SYNDIC, in government and commerce, an officer in divers countries entrusted with the affairs of a city, or other community, who calls meetings, makes representations and solicitations to the ministry, magistracy, &c. according to the exigency of the case. The syndic is appointed to answer and account for the conduct of the body, he makes and receives proposals for the advantage thereof, controls and corrects the failings of particular persons of the body, or at least procures their correction at a public meeting. In effect, the syndic is at the same time both the agent and censor of the community.

SYNECDOCHE, in rhetoric, a kind of figure, or rather trope, frequent among orators and poets. There are three kinds of synecdoches; by the first, a part is taken for the whole, as the point for the sword, the roof for the house, the sails for the ship, &c. By the second, the whole is used for a part. By the third, the matter whereof the thing is made is used for the thing itself; as steel for sword, silver for money, &c. To which may be added another kind, when the species is used for the genus, or the genus for the species.

SYNGENESIA, in botany, the name of the nineteenth class in Linnæus's system, consisting of plants in which the anthers, or male organs of generation, are united into a cylinder, the filaments on which they are supported being separate and distinct: this class contains the numerous tribe of compound flowers. The orders of this class arise from the different modes of intercommunication of the florets, or lesser partial flowers, contained within the common calyx. This intercommunication admits of the four following cases. 1. When the florets are all hermaphrodite. 2. When they are hermaphrodites and females. 3. When they are her-

maphrodites and florets of no sex: and, 4. When they are males and females.

SYNGNATHUS, the *pipe-fish*, a genus of fishes of the order Cartilaginei. Generic character: snout nearly cylindrical; mouth terminal, without teeth or tongue, and furnished with a lid; body lengthened, jointed, and mailed with many-sided scales; no ventral fins. These fishes frequent the coasts of the sea, and subsist upon worms and insects, and the ova of fishes. There are eight species, of which we shall notice the following:

S. acus, or the great pipe-fish, sometimes attains the length even of three feet, but is generally only fourteen inches long, extremely slender, and tapering towards the extremity. Its ova are found lying, in spring, in a longitudinal channel at the bottom of the abdomen, and the young are produced from this groove, completely formed. It is found in the seas of Europe.

The S. hippocampus, or sea-horse pipe-fish, inhabits the shores of the European and Indian seas, and is about ten inches long. When the head is bent downwards, it has a very considerable resemblance to that of a horse.

S. foliatus, or the foliated pipe-fish, is the most singular species of the genus, and this singularity consists chiefly in its possessing appendages, situated on very strong and rough spines, on the back, tail, and abdomen, of the shape of leaves, and which might easily be supposed, by a cursory observer, the real leaves of some of the fuci tribe. In the one presented to Sir Joseph Banks, and engraved in Shaw's Zoology, there are fourteen of these curious processes. This animal presents one of the most extraordinary objects exhibited by nature in the immense variety of her living productions. See Pisces, Plate VI. fig. 3.

SYNOD, in astronomy, a conjunction, or concourse of two or more stars, or planets, in the same optical place of the heavens.

SYNODENDRON, in natural history, a genus of insects of the order Coleoptera; antennæ clavate; the club lamellate; thorax gibbous, muricate or unequal: tip filiform, horny, palpigerous at the tip. There are four species.

SYNODICAL, something belonging to a synod; thus, synodical epistles, are circular letters written by the synods to the absent prelates and churches, or even those general ones directed to all the faithful, to inform them of what had passed in the synod. For the synodical month, see the article MONTH.

SYNOVIA, the name given to a liquid secreted within the capsular ligaments of the joints, to facilitate motion by lubricating these parts. The synovia of the ox is a viscid, semi-transparent fluid, of a greenish white colour, which soon acquires the consistence of jelly, and not long after becomes again fluid, depositing a filamentous matter. Synovia mixes with water, and renders it viscid. When this mixture is boiled, it becomes milky, and some pellicles are deposited on the sides of the vessel. Alcohol produces a precipitate when added to synovia. This precipitate is albumen. After this matter is separated, the liquid still remains viscid; but if acetic acid be added, the viscidity disappears, and it becomes transparent, depositing a white filamentous substance, which resembles vegetable gluten. It is soluble in cold water, and in concentrated acids and pure alkalies. This fibrous matter is precipitated by acids and alcohol in flakes. The concentrated mineral acids produce a flaky precipitate, which is soon re-dissolved; but the viscidity of the liquid is not destroyed till they are so much diluted with water, that the acid taste is only perceptible. When synovia is exposed to dry air, it evaporates, and cubic crystals remain in the residuum, with a white saline efflorescence. The first are muriate of soda, and the latter carbonate of soda. This substance soon becomes putrid, giving out ammonia during its decomposition. By distillation in a retort, it yields water, which soon becomes putrid; water containing a portion of ammonia, and an empyreumatic oil, with carbonate of ammonia: by washing the residuum, muriate and carbonate of soda may be obtained. A small portion of phosphate of lime is found in the coaly matter. The constituent parts of synovia are the following:

Fibrous matter	11.8
Albumen	4.5
Muriate of soda	1.7
Soda	0.7
Phosphate of lime	0.7
Water	80.6
	100.0

SYNTAX, in grammar, the proper construction, or due disposition of the words of a language, into sentences, or phrases; or the manner of constructing one word

with another, with regard to the different terminations thereof, prescribed by the rules of grammar. Hence the office of syntax is to consider the natural suitableness of words with respect to one another, in order to make them agree in gender, number, person, mood, &c. To offend in any of these points, is called, to offend against syntax; and such kind of offence, when gross, is called a solecism, and when more slight, a barbarism. Syntax is generally divided into two parts, *viz.* concord, wherein the words are to agree in gender, number, case, and person; and regimen, or government, wherein one word governs another, and occasions some variations therein.

SYNTHESIS, the putting of several things together, as making a compound medicine of several simple ingredients, &c.

Synthesis, in logic, denotes a branch of method opposite to analysis, called the synthetic method.

SYRINGA, in botany, *lilac*, a genus of the Diandria Monogynia class and order. Natural order of Sepiariæ. Jasmineæ, Jussieu. Essential character: corolla four-cleft; capsule two-celled. There are four species, with several varieties. The S. vulgaris, common lilac, is a shrub growing to the height of eighteen or twenty feet, dividing into many branches; those of the white sort grow more erect than the blue; and the purple, or Scotch lilac, has its branches yet more diffused. The lilac is very common in the English gardens, where it has been long cultivated as a flowering shrub. It is supposed to grow naturally in some parts of Persia; but is so hardy as to resist the greatest cold of this country.

SYRINGE, an instrument serving to imbibe, or suck in a quantity of any fluid, and to squirt or expel the same with violence.

SYRUP. See Pharmacy.

SYSTEM, in general, denotes an assemblage or chain of principles and conclusions, or the whole of any doctrine, the several parts whereof are bound together, and follow or depend on each other; in which sense we say, a system of philosophy, a system of divinity, &c.

System, in astronomy, denotes an hypothesis or supposition of an arrangement of the several parts of the universe, whereby astronomers explain all the phenomena or appearances of the heavenly bodies, their motions, changes, &c. This is more properly called the systems of the world. System and hypothesis have much the same signification, unless perhaps hypothesis be a more particular system, and system a more general hypothesis. The three most celebrated systems of the world are, the Copernican, the Ptolemaic, and Tychonic.

SYSTOLE, in anatomy, the contraction of the heart, whereby the blood is drawn out of its ventricles into the arteries; the opposite state to which is called the diastole, or dilation of the heart.

SYZYGY, in astronomy, a term equally used for the conjunction and opposition of a planet with the sun. On the phenomena and circumstances of the syzygies, a great part of the lunar theory depends. For, 1. It is shown in the physical astronomy, that the force which diminishes the gravity of the moon in the syzygies, is double that which increases it in the quadratures: so that in the syzygies, the gravity of the moon, from the action of the sun, is diminished by a part which is to the whole gravity as 1 to 89,36: for in the quadratures, the addition of gravity is to the whole gravity as 1 to 178,73. 2. In the syzygies, the disturbing force is directly the distance of the moon from the earth, and inversely as the cube of the distance of the earth from the sun. And at the syzygies, the gravity of the moon towards the earth, receding from its centre, is more diminished than according to the inverse ratio of the square of the distance from that centre. Hence, in the motion of the moon from the syzygies to the quadratures, the gravity of the moon towards the earth is continually increased, and the moon is continually retarded in its motion; and in the motion from the quadratures to the syzygies, the moon's gravity is continually diminished, and its motion in its orbit accelerated. 3. Further, in the syzygies, the moon's orbit, or circle, round the earth, is more convex than in the quadratures, for which reason the moon is less distant from the earth at the former than the latter. When the moon is in the syzygies, her absides go backwards, or are retrograde.

When the moon is in the syzygies, the nodes move *in antecedentia* fastest: then slower and slower, till they become at rest, when the moon is in the quadratures.

Lastly, When the nodes are come to the syzygies, the inclination of the plane of the orbit is least of all. Add that these several irregularities are not equal in each syzygy, but all somewhat greater in the conjunction than in the opposition.

T.

T, Or t, the nineteenth letter, and fifteenth consonant, of our alphabet, the sound whereof is formed by a strong expulsion of the breath through the mouth, upon a sudden drawing back of the tongue from the fore part of the palate, with the lips at the same time open. The proper sound of this letter is that in *tan, ten, tin*, &c. When it comes before *i*, followed by a vowel, it is sounded like *s*, as in *nation, potion*, &c. When *h* comes after it, it has a twofold sound; one clear and acute, as in *thin, thief*, &c. the other more obtuse and obscure, as in *then, there*, &c.

TABBYING, the passing a silk or stuff under a calendar, the rolls of which are made of iron or copper, variously engraven, which, bearing unequally on the stuff, renders the surface thereof unequal, so as to reflect the rays of light differently, making the representation of waves thereon.

TABERNÆMONTANA, in botany, so named in memory of James Theodore, surnamed Tabernæmontanus, from Berg Zabern, the place where he was born; a genus of the Pentandria Monogynia class and order. Natural order of Contortæ. Apocinæ, Jussieu. Essential character: contorted; follicles two, horizontal; seeds immersed in pulp. There are nineteen species, among which we shall notice the T. cymosa, cyme-flowered tabernæmontana; this is an elegant upright little tree, or shrub, about six feet in height; leaves acute, quite entire, scarcely waved, half a foot long. Cymes ample, handsome, convex, axillary; flowers without scent, dirty white, or reddish brown, about forty in a cyme; tube of the corolla, quinquangular, ventricose at the base; stamens in the enlarged base of the tube; stigma margined at the base; follicles oblong, very blunt, curved in, very large, reddish, with rust coloured spots; one of each pair is commonly abortive; the pulp is orange-coloured. It is found in the woods and coppices about Carthagena in New Spain, flowering in July and August.

TABES *dorsales*, in medicine, a distemper which, according to a late author, is a particular species of a consumption, the proximate cause of which is a debility of the nerves.

TABLE, in perspective, denotes a plain surface, supposed to be transparent, and perpendicular to the horizon. It is always imagined to be placed at a certain distance between the eye and the objects, for the objects to be represented thereon, by means of the visual rays passing from every point thereof through the table to the eye; whence it is called perspective plane.

TABLE, among the jewellers. A table-diamond, or other precious stone, is that whose upper surface is quite flat, and only the sides cut in angles; in which sense a diamond, cut table-wise, is used in opposition to a rose-diamond.

TABLE is also used for an index or repertory, put at the beginning or end of a book, to direct the reader to any passage he may have occasion for: thus we say, table of matters, table of authors quoted, &c. Tables of the Bible are called concordances.

TABLE, in mathematics, system of numbers calculated to be ready at hand for the expediting astronomical, geometrical, and other operations: thus we say, tables of the stars; tables of sines, tangents, and secants; tables of logarithms, rhumbs, &c.; sexagenary tables; loxodromic tables, &c.

TACCA, in botany, a genus of the Hexandria Monogynia class and order. Natural order of Coronariæ. Narcissi, Jussieu. Essential character: calyx six parted; corolla six-petalled, inserted into the calyx; anther bearing; stigma stellate; berry dry, hexangular, many-seeded, inferior. There is only one species, *viz*. T. pinnatifida; the root of which is tuberous, composed of many tubers heaped together, here and there emitting fibres; radical leaf, subsolitary, petioled, ternate, or biternate; leaflets laciniate pinnatified, acute, spreading, decurrent a little along the sides of the petiole, a foot in length; scape half a fathom in height, herbaceous, fistular, grooved towards the top, erect; umbel terminating, sessile; peduncles four to eight; anthers twelve, on short filaments; germs three, or one three-lobed; styles three, short: stigma obcordate, two-lobed; berry black; seeds brown. It is a native of the East Indies, China, Cochin China, Banda, and the Society Isles.

TACK, in a ship, a great rope, having a wale-knot at one end, which is seized or fastened into the clew of the sail; so is reefed first through the chesse-trees, and then is brought through a hole in the ship's side. Its use is to carry forward the clew of the sail, and to make it stand close by a wind: and whenever the sails are thus trimmed, the main-tack, the-fore-tack, and mizen-tack, are brought close by the board, and haled as much forward on as they can be. The bowlings also are so on the weather-side; the lee-sheets are haled close aft, and the lee-braces of all the sails are likewise braced aft. Hence they say, a ship sails or stands close upon a tack, *i. e.* close by the wind. The words of command are, hale aboard the tacks, *i. e.* bring the tack down close to the chesse-trees. Ease the tack, *i. e.* slacken it, or let it go, or run out. Let rise the tack, *i. e.* let all go out.

The tacks of a ship are usually belayed to the bitts, or else there is a chevil on purpose to fasten them.

Tack *about*, in the sea-language, is to turn the ship about, or bring her head about, so as to lie the contrary way. In order to explain the theory of tacking a ship, it may be necessary to premise a known axiom in natural philosophy, "that every body will persevere in a state of rest, or of moving uniformly in a right line, unless it be compelled to change its state by forces impressed; and that the change of motion is proportional to the moving force impressed, and is made according to the right line in which that force is exerted." By this principle it is easy to conceive how a ship is compelled to turn in any direction, by the force of the wind acting upon her sail in horizontal lines. For the sails may be so arranged as to receive the current of air either directly, or more or less obliquely; hence the motion communicated to the sails must of necessity conspire with that of the wind upon their surfaces. To make the ship tack, or turn round with her head to the windward, it is therefore necessary, after she has received the first impression from the helm, that the head-sails should be so disposed as to diminish the effort of the wind, in the first instant of her motion, and that the whole force of the wind should be exerted on the after sails, which, operating on the ship's stem, carries it round like a weathercock. But since the action of the after sails, to turn the ship, will unavoidably cease when her head points to the wind-ward, it then becomes necessary to use the head-sails, to prevent her from falling off, and returning to her former situation. These are accordingly laid aback on the lee-side, to push the vessel's fore part towards the appointed side, till she has fallen into the line of her course thereon, and fixed her sails to conform with that situation.

TACKLE, or Tackling, among seamen, denotes all the ropes or cordage of a ship, used in managing the sails, &c. In a more restrained sense, tackles are small ropes running in three parts, having at one end a pendant and a block; and at the other end, a block and hook, to hang goods upon that are to be heaved into the ship or out of it. See Ship.

TACTICS, in their general acceptation, relate to those evolutions, manœuvres, and positions, which constitute the main spring of military and naval finesse: they are the means whereby discipline is made to support the operations of a campaign, and are, in every regular service, studied for the purpose of training all the component parts according to one regular plan or system; whereby celerity, precision, and strength, are combined, and the whole rendered completely efficient. Of military tactics, the Romans may be considered the first nation whose military array could be termed regular, and whose forces maintained that order, which rendered each inferior individual subject to the control of certain subaltern officers commanding small bodies, corresponding with our sections; which being again compacted under officers of a second class, formed small divisions, as in our platoons, or companies; and which divisions being collected under a third class of officers, constituted what we term battalions. The soldiers of ancient Italy were not only inured to great hardships, as a part of their usual exercise, but were taught many evolutions suited to the modes of warfare in those days.

Time has occasioned a considerable change in that particular; for since the invention of gunpowder, our battles have frequently been decided by distant cannonades; and by no means resembled those arduous conflicts in which the heroes of old used to engage, individually contending for the day, and causing the whole field to resemble an infinity of single combats. In this practice all barbarous nations seem uniformly to agree; the sword, the tomahawk, the club, &c. being the chief instruments; though in some instances the javeline, or spear, or the bow and arrow, may be primarily re-

sorted to. Hence such warfare is far more sanguinary than that carried on with fire-arms; which rarely do much execution, unless when aided by artillery, and then only when at such distances as to be within reach of case-shot. It will no doubt surprise most of our readers, but is strictly true, that, taking the average quantity of musket ammunition expended, as a sum to be divided by the number of killed and wounded, not more than one shot in fifty will be found to take effect. Thus, after a batallion of 1000 men may have fired 20 rounds per man, making in all 20,000 discharges of musketry, they will have made terrible havoc if 400 of the enemy be disabled.

Hence we find, that the great features in decisive actions are few indeed; and they depend chiefly on tactics. Thus where a large force is brought to bear upon any particular point, while the enemy is kept in ignorance as to the object in view; or where certain advantages of locality are gained, merely by dint of superior science in the art of conducting troops by the shortest means, and in the greatest order; or where by certain evolutions a small force is made to supply the purpose of a larger, or to resist, independently of entrenchments, &c. a more numerous body; all these evince the presence of the man of tactics, and qualify him for the designation of "an able General."

We have also another branch, which is in a degree secondary, because it depends greatly on the success of the former; namely, the arrangement, or disposition, of a line, in such manner as may allow each description of force to act with effect: this can be done only when the nature of the service to be performed is suited to the nature of the troops by which it is to be attempted. In this we necessarily mean to restrict the operations of infantry to storming parties, cavalry to champaign operations, and artillery to situations where it can be duly protected, while rendering essential service. Hence the able tactician always arranges his force in such manner, as to allow each to perform its duty without interfering with the evolutions of any other class; and, in what is called manœuvring his army, never fails to estimate the distances, and the time in which each may execute the assigned duty; so that the whole may coincide with one great intention, and insure success, by the accurate execution of its respective functions: were it to be otherwise, the whole must be subject to disorder; one failure often leading to the most serious consequence; the same as is caused by the want of a cog, or tooth, of any wheel in a piece of machinery. From this it may be seen how great a superiority that commander must possess, who, by means of this science, fully comprehends the most ready arrangement of troops, where change of position becomes necessary; and who has, in the first instance, so disposed them as to be able to make those changes (even under the disadvantages ever attendant upon such necessity) with celerity, and in good order.

But, however skilful the commander, the whole of his good qualities will be abortive, unless the materials wherewith he is to perform his part be duly prepared in every respect. It is indispensably requisite, that every individual soldier should be so far trained, as to comprehend fully the general intention of every internal service of the company of which he is a part. He must have a complete knowledge of the parade duties, and consider himself as a mere automaton, under the guidance of a superior, or disposing, power: he must be cool, obedient, and passive; and he must possess a sufficient share of physical powers, and of activity, to enable his participating in the movements of the company at large. This, which is assuredly a most important matter, nevertheless has been only within a few years properly attended to: it was formerly considered fully sufficient if the soldier could wheel, face about, and fire with correctness; the conducting of a regiment through its evolutions during an engagement being left entirely to its commander. It is true, the pageantry of home duties was rather ostentatious, and wondrous pains were taken to go through a review with eclat; but the drum and fife were considered indispensable; without them, the soldier could not preserve the cadence; he had no regulated length of pace—no regulated time for various evolutions. Now, that we see how much the whole depends on its parts, each individual is trained systematically, and enters the field fully qualified to act without more instruction, at the moment, than is needful to convey to the corps at large the general intention: this not only prevents confusion, but gives to each a certain confidence, both in his comrades and in himself. Habituated to certain regulated paces, independent of musical bias, each soldier preserves his situation with correctness, and feels himself, in all situations, fully competent to fulfil the orders of his officer.

TACTICS.

We shall endeavour to explain, in as brief terms as the subject may admit, the manner in which the British forces are now trained; commencing with the first stages of the recruit's tuition, and proceeding, in a regular course, through the operations of companies, battalions, and lines; whereby the chain of connection will be best preserved, and the whole be duly exhibited. The following preamble, taken from the "Rules and Regulations for Formation, Field Exercise, and Movements, of his Majesty's Forces," is so admirably suited to our purpose, that we present it to our readers as the best preparation we can afford:

"The great object in view is, one general and just system of movement, which, directing the government of great as well as of small bodies of troops, is to be rigidly conformed to, and practised by, every regiment in his Majesty's service. To attain this important purpose, it is necessary to reconcile celerity to order; to prevent hurry, which must always produce confusion, loss of time, unsteadiness, irresolution, inattention to command, &c.; and to insure precision and correctness, by which alone great bodies will be able to arrive at their object in good order, and in the shortest space of time; to inculcate, and to enforce, the necessity of military dependence, and of mutual support in action, which are the great ends of discipline; to simplify the execution, and to abridge the variety of movements, as much as possible, by adopting such only as are necessary for combining exertions in corps, and that can be required or applied in service, regarding all matters of parade and show merely as secondary objects; to ascertain to all ranks the part each will have to act in every change of situation that can happen, so that explanation may not retard at the moment that execution should take place; to enable the commanding officer of any body of troops, whether great or small, to retain the whole relatively, as it were, in his hand and management, at every instant, so as to be capable of restraining the bad effects of such ideas of independent and individual exertion as are visionary and hurtful, and of directing them to their true and proper objects, those of order, of combined effort, and of regulated obedience, by the united force of all which a well disciplined army can only be defeated. The rules laid down will be found few, simple, and adapted to the understanding of every individual; but they will require perfect attention in all ranks. In the soldier, an equal and cadenced march, acquired and confirmed by habit, independently of music or sound: in the officer, precision and energy of command; the preservation of just distances; and the accurate leading of divisions on given points of march and formation. These circumstances, together with the united exertions of all, will soon attain that precision of movement, which is so essential, and without which valour alone will not avail."

After this, the work in question proceeds to state: "The recruit must be carried on progressively; he should comprehend one thing before he proceeds to another, and he should not be uselessly fatigued; he is to be trained singly and in squad; nor is he to be allowed to join in battalion until he may be confirmed in every requisite; for one awkward man will frequently derange a whole line." The incipient parts of instruction, however simple they may appear, are by far the most difficult to inculcate; but they are of the most imperious consequence: when a good foundation is obtained, the work will proceed with rapidity and firmness, and the pupil will, from being sensible how much he has acquired at the onset, move and act, throughout the ulterior stages, with promptitude and confidence. Standing perfectly silent and motionless, fixing his eyes steadily either to the front, or to the right or left, as may be ordered; dressing up to the same line with others; carrying his body erect, the toes turned out, the limbs firm, but pliant, erect, raised, and his weight rather borne on the fore than on the hind parts of the feet, are all matters tending greatly to his perfection. He learns to face to the right and left, or about; to move forward in a perfectly straight line, without losing squareness to the front; to move obliquely to the right or left, under the same precaution; and to mark time, to step out, or to step short; to change feet when he does not move with the rest of the company; to close, (or take room,) to the right or left, by the side step; to change from quick to ordinary time, or *vice versa*, with unerring readiness: to march in file; to wheel either forward or backward; and, in general, to acquire a habitude of acting in concert with his companions in arms, so as not only to avoid embarrassing them, but proving a firm support, and becoming a manageable tool in the hands of his officer. All these are indispensably necessary to be fully

acquired; they must be so perfectly familiar, as to seem rather the effect of instinct than of education.

Thus much being duly attained, the recruit is instructed in the use of arms, in which he cannot be too perfect: the great difficulty is to impress him, in a sufficient manner, with the advantages of close motion, and of preserving the body from distortion, or change of position, so far as relates to uprightness, squareness to the front, and undeviating attention to dressing in line. For it is to be observed, that unless very great strictness be observed on the part of the drill serjeant, the whole course will be perverted by the handling of the musket. It would not suit our purpose, nor could it be equal to the views of our readers, were we to enter upon all the details regarding the motions of the firelock; or what is called the manual exercise: in the present posture of political affairs, such would be perhaps unnecessary; it having, within these few years, become the duty of many, and the amusement of all, to acquire some knowledge of that branch of discipline: we shall therefore proceed to treat of the firings, which constitute a very principal part of the soldier's duty, and greatly interest both the officers commanding divisions, and those in charge of whole battalions. We must, at the same time, express our hope, that the frivolous practice of expending so many rounds of light cartridges will be in time much curtailed; in order to make way for a more extended practice with ball; the propriety of enforcing a correctness of aim must be self-evident; and is considerably enhanced by the little execution done by musketry, as has already been shown.

Troops are drawn up in two or three ranks, according to the nature of the service on which they are to be employed, or the enemy to which they are to be opposed. To resist the charge of cavalry, it is found that three ranks are preferable; as is also the case where an enemy advances *en masse*, or bears down in column; in this arrangement, the front being diminished one third, many objections may be urged under local circumstances, especially when acting behind entrenchments, when covered by morasses, or when the enemy cannot advance with rapidity in compact heavy bodies. The mode of drawing up in two ranks is peculiarly adapted to the foregoing, and on some occasions must be adopted, in spite of every adverse argument, for the purpose of extending a front; add to this, that both the round and the grape shots, from the enemy's artillery, do less execution among two, than when three ranks are opposed to them. When a battalion is drawn up in two ranks, they both fire standing; but when in three ranks, only the two rear ranks fire, whilst the front kneels, and presents a formidable impediment to the charge of an enemy, both by its reserved fire, and by its line of sloped bayonets.

According to our improved system of discipline, one officer and one covering serjeant perform all the evolutionary duties of each company, when formed in line; the rest being disposed of in the rear, for the purposes of keeping the men to their duty, and of being in readiness to take command of those lesser portions into which the companies occasionally break. By this arrangement the utmost precision is secured; especially as select men are placed on the flanks of all the companies, also of their sub-divisions and sections, whose duty it is to regulate their wheelings, or changes of locality, by constantly preserving the distances and alignements of their respective portions.

Perhaps among the greatest improvements of the day, we may count the modern method of marching by files; formerly this was effected in a kind of open order, the leaders gradually gaining distance, so as to give a greater space between the files, under the apprehension of treading on each other's heels; but it is now the practice to make every soldier retain the same distance on all occasions from his neighbours; by which means, the right leg of one crosses at the side of the left leg of the other, and *vice versa*. It is obvious, that while the leaders were allowed to gain ground, so as to open the distances between the several files, some time was required for the rear files to close up after the front had halted; and that, if the battalion were to be ordered to front while in the act of marching by files, under the old system, it would appear of double its due extent: for they would be so distant as to allow space for an additional file between every man in the ranks. Our readers cannot fail to perceive the high importance of keeping troops always to the same extent of front as when formed in line; for if allowed to vary, from any inattention to regularity, it would be utterly impossible for the commander to perform his evolutions upon a

given scale; or for any dependance to be placed on the exertions of a line, (particularly in resisting a charge,) of which the solidity, that is, the compactness, could not be ascertained.

The extreme difficulty which prevails in the ordinary course of actual service, in keeping the due distances between marching files, has in a great measure rendered that mode obsolete: besides, the facility with which troops move in small divisions, or even by whole companies, in column, &c. whereby intervals are left between them, tending greatly to the convenience and ease of the men, certainly gives the latter mode every claim to preference, except under particular local circumstances. But even in proceeding by files, it is best to march by fours, causing the files to be doubled previous to stepping off. By this means, the whole corps is broken into ranks of four men each, with one space interval between the several ranks. A battalion, thus arranged, is formed in an instant, by the files resuming their places. Yet it cannot be said that this method is so eligible as that of marching by divisions, especially when consisting of only two ranks: in such case the front rank moves on with perfect freedom, each man seeing the obstacles he is to surmount many paces before he arrives at them; and the rear rank, keeping a well opened distance, is considerably liberated, in consequence of the great interval behind it. Add to this, the promptness with which the line can be formed either to the right or left, by the several divisions wheeling up accordingly.

We shall now proceed to show the operations of a body of men according to the existing regulations, illustrating the several movements by means of figures, which will be found in Plate XV. Miscellanies: they will suffice to give a general idea of the evolutions of armies on a large scale, as well as of small parties, the principles of motion being the same in both.

The first matter requiring consideration is the act of wheeling, which may be performed either to a given point, say to the right; or on a given point, say on the left; in either case, the front will be to the right. But when a body of men has wheeled to the right, as A, in fig. 11, changing place to B, and that it be required to wheel up into line, *i. e.* to the left, such body will have gained both to the right and to the front equally; the intermediate angle being 90°, and the third position, C, standing at an angle of 45° from the position, A. Consequently a succession of wheeling to the right and left alternately, will occasion the several positions, in succession, to represent an *escalier*, or flight of steps. It requires, therefore, but little demonstration to show the utility of wheeling backward on the left, in the first instance, to proceed along an alignement, O Q; because the troops, by wheeling to the left, would always come up to the line of their left hand pivots (or files.) Simple as it may seem, this precaution is not yet sufficiently understood, or, at least, not invariably attended to; whereby many oblique movements are made to remedy the error thus generated.

But troops do not always make a full wheel, *i. e.* of 90°, in many instances, as in fig. 12; where an oblique position, D, is to be taken, the whole line, F, wheels by small divisions, only an octavo, *i. e.* the eighth of the circle, corresponding with 45°, and thus show a succession of fronts, like the teeth of a saw, all parallel to the new position of 45°. This is called *echellon* (a French term, signifying the steps of a ladder). Where the angle of the new position is more or less acute than 45°, the wheel may be made to correspond nearly therewith; so that, when the different divisions march to their several places in the new line, they may move fully to their fronts, and come up square into their places. Where the ground is bad, and that file marching is necessary, the line may wheel to the right in *echellon*, to the requisite angle, to point the left flanks of the divisions to their proper situations in the new line, F. When the right or left flank of a corps is the pivot for the new direction, it becomes a *point d'appui*, and the division nearest thereto is arranged properly upon the new line, where it remains as a guide for the others, which, arriving in succession, prolong the new front. The *echellon* movements may be considered peculiarly safe, at the same time that they are rapid and regular; the line may be formed instantly, provided the leaders of the several divisions preserve their appropriate distances.

It is to be remarked, that *echellon* movements may be made in any direction, whether to front or rear; the divisions wheeling to front or rear accordingly;

thus, in fig. 13, which represents a change of from G to H, as the new direction runs through the old one, those divisions which are to be in front wheel forward, while those which are to be in the rear of the first position, G, face about, and wheel towards the rear; observing that the whole wheel the same way, *i. e.* to the right. The two companies nearest the line, H, may be previously posted thereon to advantage, so as to be settled by the time the word is given for the others to march. When those of the rear have come to their places, they face about to the front, and dress. And here it is necessary to remark, that the exterior flank of every company, after being settled in its post, becomes the *point d'appui* for the next which is to arrive, and to place itself on that flank; but that the officer always looks from the *point d'appui* towards some object, such as a banneret, or a staff officer, &c. fixed as a guide for the alignement at that point, which is to be on the flank, as at S S in this example.

The column, which is one of the most frequent and important figures of the tactic system, may be found in a variety of modes; the most ordinary is by wheeling, either wholly, or in *echellon*; but it is often useful to form it by the march of divisions in files towards their posts, as shown in fig. 14. When this is done, three files (the leading ones) of each division turn towards their new stations, at which their several pivot-men are ready placed; the whole, when ordered, march towards those men, and when the division, on which the column forms, is duly covered, each company, in succession, fronts in conformity with that division.

This figure shows a battalion, &c. forming upon its sixth company, the left in front; to effect this, the five divisions, on the right, file from their left flanks, and proceed to place themselves behind the sixth company; while the two companies of the left file from their right flanks, towards the front, and cover. Our readers will perceive, that this is on the same principle as the change of front already described; in fact, the formation of a column is tantamount thereto; it being obvious, that the one unavoidably prepares for the other. In this we suppose the operation to be done in a proper manner; for a column may be easily formed, having its flanks reversed, so that, when ordered to wheel up into line, the flanks of companies will all be misplaced; this is called, "clubbing a battalion," meaning that it is thrown into a state of confusion.

The column may, with great advantage, be formed from the centre of a battalion, the colours moving forward, supported by the two adjunct companies, the residue of each wing facing inwards, and following its respective leading company. Thus the whole will exhibit a column of grand divisions, each of which is formed of a company from either wing. When the column is to be of only one company in width, the reserve leads off with the colours, and the companies of either wing follow alternately; in this manner the ten companies will all be separated. To form the line from such a column, it is usual either to face the whole outward, excepting the leading division, and causing each to move out direct to the direct parallel of its place in line, order them respectively to front, and move up in succession: or upon the whole facing outward, they may be led by files to their several stations. When the column is in narrow bounds, from which it cannot deploy (or unfold) in either of the above modes, the centre must halt, or step short, while the several divisions close up thereto, and then wheel, or face, to the right and left, according to the wings they may belong to, and countermarch along the rear until they arrive opposite to their respective stations in line. Fig. 15, shows the deploy from a column of grand divisions; the companies of the right wing proceeding straight forward to their parallels; the companies of the left wing leading by files into line. Fig. 16, shows a column of companies alternately from the right and left wings; the right wing making a half wheel into *echellon* of whole companies, which as they arrive at the *point d'appui* dress up into line; the companies of the left wing not having space for deploying, move up nearly to the rear of the centre, wheel to the left, countermarch along the rear of those divisions which precede them respectively, and arriving at the *point d'appui*, wheel to the right into line.

The column of grand divisions cannot always proceed; otherwise it would be by far the most eligible for the march of single battalions, in situations where the enemy's cavalry might make an attack; the grand divisions should all close up to half distance, so that when ordered to wheel up and form the square, they might leave no gap in either of the flank faces; the two rear companies moving up to the spot on which the grand division immediately preceding them wheeled off, right and left; the front companies halt-

ing during the wheel, and closing up to the centre as the reserve, with the colours, passes into their rear. When there are guns with a battalion, they move on such occasion to the angles most liable to be attacked; four pieces of cannon are needful to render a square perfectly safe; but, for their accommodation, it will be necessary for each face to move forward seven paces; whereby the interior of the square will be greatly increased, and space given for the cannon to be served at the angles; this evolution is exhibited under fig. 17.

The column *en potence*, that is, in form of a gibbet, is peculiarly deceptive; especially when that column is a close one, having no intervals between the companies; in this the whole form one solid mass. If discovered, the enemy will certainly direct their artillery towards it; thereby doing great execution. The great object of this formation is, to push forward a strong force against some particular point, so as to bear down whatever opposes it, or suddenly to form a flank where a charge of cavalry is expected; in the latter case, the rear division of the column halts until there is space enough for it to wheel, (to the right, if to secure the right flank) and, as each division does the same in succession, it is evident a line is formed, at right angles with the front line, which keeps moving on until all the divisions of the column have wheeled. We have shown, in fig. 18, how this is done on the right flank; while on the left we have shown an *echellon* flank, which moves with more ease than the close column, and is not subject to so much mischief from the enemy's artillery; but this is not so deceptive; however, it affords the advantage of being ready either to form a flank, by wheeling backwards an octave, or to move forward into line; which cannot be done from a close column without deploying.

When a column is advancing towards an enemy, it is proper that its cannon should precede it, to clear the way by their fire; but when retreating, the cannon should be in the rear, to check pursuit. The passage of rivers is generally conducted on the same principle; adverting to one point, where a choice can be made; *viz.* always to cross at a re-entering bend of the stream, as shown in fig. 19, by reference to which it will be seen, that in crossing from A to B, the passage cannot be flanked by the enemy; while it is defended by the troops which first cross: change the position, and cross from B to A, and the enemy will flank the passage, which you cannot defend; because they will enfilade whatever troops or cannon you post for that purpose; they having the command of a greater extent of front than yourself in the latter instance.

One of the most arduous situations in which an officer can be placed is the covering, or conducting, of a convoy; especially when heavy carriages are in question. A numerous convoy can rarely travel more than six or seven miles within the day, however favourable the roads may be; unless it may be practicable to draw two or three carriages abreast, which can be practicable on plains only; for whenever a pinch or defile might present itself, so as to occasion only one carriage to proceed at a time, though only for a few feet, as in passing a narrow bridge, it would have the same effect as if the whole day's journey were performed in single trains: this is not the case in campaign situations, because one column of waggons may keep moving on while another is stopt; and, if a carriage should break down, others may pass round it; in this way the columns should not be far distant. When we consider that a hundred waggons will cover a mile in length, we cannot but admire the frequent success of officers, perhaps with only four or five battalions under their command, in conducting convoys of many hundreds of heavy carriages, through an exposed country, from one place to another; sometimes, indeed, for full an hundred miles. On such service it is highly necessary to have a body of cavalry; else every little party of the enemy's horse would subject the convoy to perpetual danger and delay.

When a general expects a convoy, he must favour its approach and safety by every possible means: one of the best devices is, that of threatening an attack, so as to prevent the enemy from detaching his cavalry. When the convoy is near, and it is suspected that an attempt will be made to cut it off by a sudden movement, the general must, if circumstances admit, make one retrograde march with his whole force to meet it; or, if that be not practicable, he may send orders for it to follow such route as may be most under cover, or best removed from the danger of assault. We often see instances of a campaign being decided by the safe arrival, or *vice versa*, by the loss of a convoy. The utmost skill sometimes cannot oppose the overbear-

ing prowess of superior power; but, as we always suppose an army to place itself between its expected supplies and the enemy, it is evident, that if of equal force, every advantage is on its side; for the enemy, having a greater distance to march, when about to attack a convoy, than the defenders have to proceed to its rescue, and any detached party being liable to destruction while passing round the flank, it is evident, that, by retaining the intermediate situation, we may generally afford every necessary protection. When it happens otherwise, we commonly find that the enemy are superior in cavalry, which they detach to a great distance to intercept the convoy, while their infantry remains in some strong position. In such case a retreat is indispensably necessary, and reliance must be placed in the commander of the convoy, (if he is warned of the enemy's approach) being able either to take refuge under the walls of some fortified place; or on his taking possession of some village, or forming a barrier against the enemy, by drawing up his waggons, &c. to the best advantage: in such case he is virtually entrenched; his cattle and troops being within an area impenetrable to cavalry, and furnishing an excellent cover for the keeping up a most destructive fire on the assailants. If he can command a supply of water, he may do wonders; at all events, he may easily hold out until relieved.

A retreat, well managed, is usually more favourable than a dear earned victory. To insure the means of retreating, without considerable loss, a second, or even a third, line may be requisite: at all events, a reserve of select troops, with a good park of artillery, chiefly supplied with grape and case-shot, will be indispensable. The posting a reserve requires great judgment, both in regard to the enemy's designs, and the temper of your own troops.

The celebrated retreat of Moreau, through the Black Forest, placed him, *ipso facto*, on a footing with the greatest conquerors of the day; it tore from his opponent's brows those laurels which the latter claimed, in consequence of having urged the French general to quit the open country. In that instance, however, it may, perhaps, be said, and not without some show of justice, that the nature of the country was greatly in favour of the latter; but, on the other hand, it must be taken into account, that, unless most skilfully managed, a retreat before a very superior force must have been peculiarly dangerous, especially to the cavalry: we may, indeed, admire that system of tactics, which enabled Moreau to save his artillery and baggage. To do this, it is evident he must have shown a firm front, so arranged, that his opponent dared not to venture an attack. The excellence of the manœuvre consisted in the deceptions practised; for it was not until that movement, when Moreau had secured his baggage and artillery, and, as it were, buried his army among the wildernesses, that the Austrian general could believe it possible for the French to escape being captured. The device used, was a feint to escape along the skirts of the forest, which occasioned a change of position in the Austrian camp, and left Moreau at liberty to push in the opposite direction towards a pass, scarcely, indeed, passable for carriages, and thus to defy pursuit; however it answered his purpose, for he escaped with his whole army.

We cannot close this article without showing how essentially a well chosen position contributes to success. Where an army is weak in cavalry, it should invariably be parted so, that, at least, one of its flanks may be covered from the enemy's horse. By this means, if its own cavalry be held in reserve, or nearly so, but with full powers to support the open wing, the enemy must be kept in suspense, as to the point to which it will direct its charge; and be compelled, in many instances, to keep his horse divided, for the purpose of opposing that charge on either flank. A flank may be securely covered by a town, duly defended by infantry; or by a river; a morass; a thick wood; a steep hill, having a battery duly posted; or even by broken ground. In some instances, a slight intrenchment may be necessary.

Tactics, *naval*, relate to those operations in the management of a vessel, which enable her to attain any particular object, such as reaching a port, avoiding danger, gaining an advantage over an enemy, &c. In a more extended sense, they denote those manœuvres, stratagems, and deceptions, employed by the commander of a fleet, for the purpose of gaining a weathergage, cutting off any part of a line, or attacking any particular portion thereof, in such manner as may either defeat the views of a hostile fleet, or subject it to loss and discomfiture. The old system of tactics in this, as well as in the military branch, was burthened

with ceremonies, and with received opinions, which were held to be inviolable: the difference of one or two ships in favour of the enemy was considered a sufficient excuse for a variety of precautions, generally amounting to forbearance from engaging the superior power; and, although we certainly can count a number of gallant exploits performed by our fleets when somewhat inferior to the enemy, it has been reserved for latter times to exhibit what could be done by the British navy, even when opposed to nearly double their own force. This wonderful change was introduced by Rodney; who, in the year 1782, engaged the French fleet under Count de Grasse; when, by boldly cutting off a part of its rear, he compelled nearly half the enemy's force to surrender; the rest sought their safety in flight. Since that date, Admiral Jervis, by a skilful manœuvre, cut off a large portion of a Spanish fleet, near Cape St. Vincent's, (whence the peerage bestowed on him received its designation;) but the late Lord Nelson appears most conspicuous in that mode of attack which, in general, secured a victory. The battle of the Nile was doubtless a masterpiece of tactical science; it merits notice from its simplicity, and, if we may be so bold as to use the term, its infallibility. The manœuvre he used was, to throw two of his ships upon every one of the weather-most of the enemy's line, by causing his fleet to divide as it approached them, consequently including each French ship between two of ours. The residue, which were moored in a line a-head, fully expected to see ours range up their whole length, and oppose ship to ship. They saw their error when it was too late; being to leeward, it was impossible for them to render efficient aid, and they fell in detail; with the exception of a very small portion, which escaped by putting out to sea, whither we were not in a condition to follow with any hopes of overtaking them. See fig. 20.

In the famous battle of Trafalgar, in which the immortal Nelson quitted his earthly frame, the combined fleets were drawn up in the form of a crescent, and awaited our attack, which was made in a double column, apparently bearing down upon their centre. This novel mode of coming into action kept the enemy completely in suspense: it threatened every part of their line. If our two columns had turned the same way, they would have been able to do infinite damage in that quarter, before the other wing of the enemy could come up to succour their overpowered friends: if the two columns should cut through the centre, they must destroy it, and effectually separate the two wings, so as to leave them ignorant of each other's fate. Such was the fact: the enemy, though superior in numbers, lost no less than nineteen sail of the line. The reader may form some conception of that glorious event by a reference to fig. 21.

Perhaps nothing can place a fleet in a more dangerous state, and render it less able to resist an attack, than making sail before the wind, in a line of battle a-head, to avoid a pursuing enemy. In such a case, whenever the rear of that line can be brought to action, it becomes subject to an accumulating force, in consequence of the pursuing fleet thickening upon it: while the van of its own line, being to leeward, must make many tacks, or at least two long ones, before it can succour its rear. The disadvantage must be very great, even if all the ships on both sides sail upon an exact equality: but, as that is never the case, many of the flying ships will be probably driven completely to leeward, and never be able to afford the smallest assistance. Yet British seamen, even when compelled to retire before a very superior force, generally manage, by some well contrived device, to intimidate their pursuers, or to put on so good a face, as to convince them of the dear price at which the victory is to be bought. Of this we cannot quote a more appropriate instance than the escape of five sail of our ships, under the command of Admiral Cornwallis, from no less than nineteen sail of French ships of the line: an escape resulting entirely from the manœuvres of the British Admiral, whereby he fully convinced the French that a large force was at hand.

The present unparalleled state of discipline, throughout our navy, would, of itself, give us the command of the ocean; but we are greatly indebted, at the same time, to an excellent code of signals, both for the day and the night, whereby every operation and manœuvre may be directed with readiness and perspicuity. The day signals are, for the most part, made by flags, jacks, and pennants; the night signals by lanterns, blue lights, maroons, &c.: in both, the firing of guns, either to windward or to leeward, occasionally is added. When fleets are large, or their duty extensive, especially in cruizing to

intercept a convoy of merchant vessels, &c. there are repeating frigates, which display the several signals made by the commander; so that they may be communicated to all the vessels: every signal being kept flying, until answered by all ships to which they may relate.

We shall now offer to our readers some minutiæ relative to the fighting of a ship, under ordinary circumstances; observing, that under the head of NAVIGATION much will be found to instruct the learner in ascertaining a vessel's course, way, &c.; and under the head of QUADRANT, what relates to the common mode of taking observations, for the purpose of ascertaining a vessel's locality.

When orders are given to "clear ship for action," the boatswain and his mates whistle, and call, at the various hatchways, to warn all who are between decks: the hammocks, or beds, are instantly unhooked, packed, and sent on deck, to be put into the nettings on the waist, forecastle, quarters, poop, &c. where they serve as an excellent defence against musketry. While some of the seamen are thus employed between decks, others are aloft securing the yards in chain slings, so as to prevent them from falling, when the haul-yards may be severed by cannon shot; materials for repairing the rigging are also placed in readiness; shot-plugs, for stopping holes near, or under, the surface of the water, are dispensed; and every attention is paid to ascertain that the pumps are in order, so as to clear the hold in case of leaks. The decks are cleared of every incumbrance, by the removal of chests, &c. into the hold; the various gun-tackles are inspected; and all the necessary implements, such as powder-ladles, worms, rammers, sponges, &c. are duly supplied. All being ready, the surgeon and his mate, together with the chest of medicines, instruments, bandages, &c. are prepared in the cock-pit; that is, down the hatchway, below the ordinary reach of the enemy's shot. The officers and men repair to their posts, the powder-room is opened, the hatches are all laid, the marines drawn up on the forecastle, quarter-deck and poop, the guns are run out and levelled, and the courses, (that is, the lower sails,) are clued up, to prevent their being set on fire by the discharges from the cannon; also to render the ship more manageable.

The greatest attention is always paid to taking a good aim before a gun is fired, that every shot may hit some part of the enemy's hull; the nearer to the water's edge the better. The captain, master, purser, &c. remain on deck to fight the ship, and to note down all occurrences, while the signal master attends to and answers whatever signals may be thrown out by the commander of the fleet or division. It is ever a primary object to place the ship in such a position as may annoy the enemy most; yet, at the same moment, evade his principal defences: this is best done, by laying diagonally upon her quarter, or bow, and especially across her stern, so as to rake her fore and aft; whereby her guns will soon be dismounted, and the men driven from their quarters.

This description of the manner in which the battle is carried on by each ship, will serve as an illustration of the whole; but it may be necessary to add, that the disposition of a fleet must be suited to the position the adversary may have assumed. When an enemy opposes a direct line, opposite to that of his own fleet, the admiral rarely does more than make the signal for line of battle abreast, perhaps a cable's length asunder, thus coming at once to close engagement, ship opposed to ship, or rather the two fleets intermixed alternately, their heads laying different ways: if they should pass each other, it is usual to put about, and resume the engagement in the same manner. When the enemy bear down in a line a-head, it it customary to receive them in the same manner, to prevent their cutting off a part of the line; this depends greatly on the direction of the wind: but if it be on the beam, that is, full on the side, or in any direction affording the means of aiding your van, without delay, by a press of sail, such a mode of attack will subject the enemy to have his own line cut, as was done by Rodney; or doubled upon, as in the battle of the Nile.

During an engagement, the courses are commonly hauled up, as before stated; the top-gallant-sails and stay-sails are also furled. The movement of each ship is chiefly regulated by the main and foretop sails, and the jib, reserving the mizen to fill, or to be thrown aback, as an aid, either to accelerate the ship, or as a check to prevent her passing the enemy. The frigates, tenders, and other small vessels, generally lay to, or hover about in the rear, to repeat signals, or to aid crippled ships. These, not being considered as ships of the line, are not attacked, except by vessels of their own class; therefore, when a fleet is not well manned, it

is common to take all the spare hands from such, to assist on board the fighting ships. When a fleet is superior in numbers, it is proper to keep some of them in reserve, stationing them behind the weaker parts of the line, to succour such as may, by the loss of masts, &c. become unmanageable, and to take advantage of any opportunity to chase, and lay aboard of whatever of the enemy's ships may quit the line for the purpose of escaping. In order to observe what is going on, the admiral generally removes to some frigate, on board which he hoists his flag; near him should be some of the best sailing cutters, brigs, &c. to convey orders which could not be accurately delivered by signal, or by telegraph.

Boarding is most commonly resorted to by privateers, in their attacks upon merchant vessels; but among ships of the line is rarely practised. Our commanders are perhaps more forward than those of any other nation, except the Turks, in this kind of enterprize, which is replete with hazard. The best mode of boarding, especially if there be any swell, is to keep on the enemy's weather quarter; now and then, if the sailing of your ship will allow, yawing, so as to throw your fire into her stern: when, by this means, you have done any execution, it will be proper to pass close under the enemy's stern, raking her fore and aft, with your guns double shotted, and then lay her aboard upon her lee beam, having your tops well manned, to fire upon the enemy's decks, on which also grenades, stinkpots, fire-balls, &c. should be discharged. Having grappled the ship to your adversary's chains, your boarders jump into her, under the cover of the fire of your small arms. In case of repulse, the attack to leeward is most favourable to the retreat of your men; besides, it is far easier to cast off from the enemy, than it would be if you were to windward of her.

TÆNIA, in natural history, *tape-worm*; body flat, and composed of numerous articulations: head with four orifices for suction, a little below the mouth: mouth terminal, continued by a short tube into two ventral canals, and generally crowned with a double series of retractile hooks or holders. Gmelin has enumerated almost one hundred species, besides varieties: he has divided them into sections. A. Those found in other parts besides the intestines, and furnished with a vesicle behind. B. Those found in the intestines only, and without a terminal vesicle. C. Those with the head unarmed with hooks. The worms of the first section are found infesting Mammalia, reptiles, and fish. Those of the second section are found in the Mammalia, in birds, and in fish; and those of the third section infest Mammalia, birds, reptiles, and fish. This genus of worms are destined to feed on the juices of various animals, and are usually found in the alimentary canal, generally at the upper part of it. They are sometimes found in great numbers, and occasion the most distressing disorders. They have the power of reproducing parts which have been broken off, and are therefore removed with the utmost difficulty: they are oviparous, and discharge their eggs from the apertures on the joints. We shall give a few of the more remarkable species.

1. T. visceralis, which is inclosed in a vesicle, broad in the fore part, and pointed in the hinder part; inhabits the liver, the placenta uterina, and the sac which contains the superfluous fluid of dropsical persons. 2. T. cellulosa, which is inclosed in a cartilaginous vesicle, inhabiting the cellular substance of the muscles; is about an inch long, half an inch broad, and one-fourth of an inch thick, and is very tenacious of life. 3. T. dentata, has a pointed head; the large joints are streaked transversely, and the small joints are all dilated; the osculum or opening in the middle of both margins is somewhat raised. It is narrow, ten or twelve feet long, and broad in the fore parts: its ovaria are not visible to the naked eye: and the head underneath resembles a heart in shape. It inhabits the intestines. 4. T. lata, is white, with joints very short and knotty in the middle; the osculum is solitary. It is from eighteen to one hundred and twenty feet long; its joints are streaked transversely; its ovaria are disposed like the petals of a rose. 5. T. vulgaris, has two lateral mouths in each joint; it attaches itself so firmly to the intestines, that it can scarcely be removed by the most violent medicines; it is slender, and has the appearance of being membranaceous; it is somewhat pellucid, from ten to sixteen feet long, and about four lines and a half broad at one end. 6. T. truttæ, which chiefly inhabits the liver of the trout. 7. T. solium, has a marginal mouth, one on each joint. 8. T. ovilla, found in the liver and omentum of sheep. 9. T. celebralis, is aggregate; numerous animalcules united by their base to a large common vesi-

cle, distributed about the surface, and retractile within it. This is found in vast numbers in the brain, or spinal marrow, immediately beneath the brain of sheep. These noxious animalcules occasion giddiness and staggering, and the disease known by the name of the dunt or rickets: which, if the containing vesicle be broken, is incurable; for these minute worms, in size scarcely larger than a grain of sand, are each of them furnished with from thirty-two to thirty-six hooks on the head, by which they fix themselves firmly to the substance of the brain, or its coats.

The structure and physiology of the tænia are curious, and it may be amusing as well as instructive to consider it with attention. The tænia appears destined to feed upon such juices of animals as are already animalized; and is therefore most commonly found in the alimentary canal, and in the upper part, where there is the greatest abundance of chyle; for chyle seems to be the natural food of the tænia. As it is thus supported by food which is already digested, it is destitute of the complicated organs of digestion. As the T. solium is most frequent in this country, it may be proper to describe it more particularly.

It is from three to thirty feet long, some say sixty feet. It is composed of a head, in which are a mouth adapted to drink up fluids, and an apparatus for giving the head a fixed situation. The body is composed of a great number of distinct pieces articulated together, each joint having an organ by which it attaches itself to the neighbouring part of the inner coat of the intestine. The joints nearest the head are always small, and they become gradually enlarged as they are further removed from it; but towards the tail a few of the last joints again become diminished in size. The extremity of the body is terminated by a small semicircular joint, which has no opening in it.

The head of this animal is composed of the same kind of materials as the other parts of its body; it has a rounded opening at its extremity, which is considered to be its mouth. This opening is continued by a short duct into two canals; these canals pass round every joint of the animal's body, and convey the aliment. Surrounding the opening of the mouth, are placed a number of projecting radii, which are of a fibrous texture, whose direction is longitudinal. These radii appear to serve the purpose of tentacula for fixing the orifice of the mouth, as well as that of muscles to expand the cavity of the mouth, from their being inserted along the brim of that opening. After the rounded extremity or head has been narrowed into the neck, the lower part becomes flatted, and has two small tubercles placed upon each flatted side; the tubercles are concave in the middle, and appear destined to serve the purpose of suckers for attaching the head more effectually. The internal structure of the joints composing the body of this animal is partly vascular and partly cellular; the substance itself is white, and somewhat resembles in its texture the coagulated lymph of the human blood. The alimentary canal passes along each side of the animal, sending a cross canal over the bottom of each joint, which connects the two lateral canals together.

Mr. Carlisle injected with a coloured size, by a single push with a small syringe, three feet in length of these canals, in the direction from the mouth downwards. He tried the injection the contrary way, but it seemed to be stopped by valves. The alimentary canal is impervious at the extreme joint, where it terminates without any opening analogous to an anus. Each joint has a vascular portion occupying the middle part, which is composed of a longitudinal canal, from which a great number of lateral canals branch off at right angles. These canals contain a fluid like milk.

The tænia seems to be one of the simplest vascular animals in nature. The way in which it is nourished is singular; the food being taken in by the mouth, passes into the alimentary canal, and is thus made to visit, in a general way, the different parts of the animal. As it has no excretory ducts, it would appear that the whole of its alimentary fluid it fit for nourishment; the decayed parts probably dissolve into a fluid which transudes through the skin, which is extremely porous.

This animal has nothing resembling a brain or nerves, and seems to have no organs of sense but those of touch. It is most probably propagated by ova, which may easily pass along the circulating vessels of other animals. We cannot otherwise explain the phenomena of worms being found in the eggs of fowls, and in the intestines of a fœtus before birth, except by supposing their ova to have passed through the circulating vessels of the mother, and by this means been conveyed to the fœtus.

The chance of an ovum being placed in a situation where it will be hatched, and the young find convenient subsistence, must be very small; hence the necessity

for their being very prolific. If they had the same powers of being prolific which they now have, and their ova were afterwards very readily hatched, then the multiplication of these animals would be immense, and become a nuisance to the other parts of the creation.

Another mode of increase allowed to tænia (if we may call it increase) is by an addition to the number of their joints. If we consider the individual joints as distinct beings, it is so; and when we reflect upon the power of generation given to each joint, it makes this conjecture the more probable. We can hardly suppose that an ovum of a tænia, which at its full growth is thirty feet long, and composed of four hundred joints, contained a young tænia, composed of this number of pieces; but we have seen young tæniæ not half a foot long, and not possessed of fifty joints, which still were entire worms. We have also many reasons to believe, that when a part of this animal is broken off from the rest, it is capable of forming a head for itself, and becomes an independent being. The simple construction of the head makes its regeneration a much more easy operation than that of the tails and feet of lizards, which are composed of bones snd complicated vessels; but this last operation has been proved by the experiments of Spallanzani and many other naturalists.

TAFFETY, in commerce, a fine smooth silken stuff, remarkably glossy. See SILK. There are taffeties of all colours, some plain, and others striped with gold, silver, &c. others chequered, others flowered, &c. according to the fancy of the workmen.

TAGETES, in botany, *marygold*, a genus of the Syngenesia Polygamia Superflua class and order. Natural order of Compositæ Oppositifoliæ. Corymbiferæ, Jussieu. Essential character: calyx one-leaved, five-toothed, tubular; florets of the ray five, permanent; down with firm erect chaffs; receptacle naked. There are four species, and several varieties; the T. erecta, African marygold, is from three to four feet in height, divided from the middle into many branches, each bearing one large flower; leaves long, pinnate; leaflets dark green; flowers yellow, from brimstone to orange colour; of this there are five varieties, all annuals.

TALC, in mineralogy, is divided into three sub-species, *viz.* 1. The earthy talc, which is of a greenish white colour, composed of glimmering pearly small scaly parts: it soils a little, and feels rather greasy. It occurs in the tin mines near Freyburg, in Saxony. 2. Common Venetian talc is of an apple green, which passes on one side into greenish white, and even into silver white; on the other, into asparagus green. It is massive, disseminated, and in extremely delicate crystals. It is splendent and shining: feels very greasy, and is easy frangible. It is infusible before the blow-pipe, without addition; and its constituent parts are,

Magnesia	44
Silex	50
Alumina	6
	100

This is frequently confounded with mica, from which it is, however, distinguished by want of elasticity; by its greasy feel, and colour. It is almost entirely confined to the primitive mountains, where it occurs in beds, imbedded in serpentine, and also in veins. It abounds in the mountains of Tyrol and Salzburg, hence it is brought to Venice, and on that account has obtained the name of Venetian talc. It is employed as a basis for coloured crayons, and for the finest rouge.

3. Indurated talc is of a greenish grey colour: it occurs massive; lustre shining, passing to glistening, and is pearly, feels rather greasy. It occurs in primitive mountains, where it forms beds in clay, slate, and serpentine. It is thought to be an intermediate link between steatite and pot-stone, which see. It is found in the Alps, in Stiria, and in Austria, and Hungary: also in some parts of Scotland: the constituent parts are,

Magnesia	38.54
Silica	38.12
Alumina	6.66
Lime	0.41
Iron	15.02
	98.75
Loss	1.25
	100.00

TALENT, money of account amongst the ancients. Amongst the Jews, a talent in weight was equal to sixty maneh, or 113 lb. 10 oz. 1 dwt. 10 $\frac{2}{7}$ gr.

TALES, *i. e. tales de circumstantibus*, bystanders, is used in law for a supply of men empannelled on a jury, and not ap-

pearing, or on their appearance challenged and disallowed, when the judge, upon motion, orders a supply to be made by the sheriff of one or more such persons as are present in court, to make up a full jury.

TALLOW *tree*, a remarkable tree, growing in great plenty in China; so called from its producing a substance like tallow, which serves for the same purpose; it is about the height of a cherry-tree, its leaves in form of a heart, of a deep shining red colour, and its bark very smooth. Its fruit is inclosed in a kind of pod, or cover, like a chesnut, and consists of three round white grains, of the size and form of a small nut, each having its peculiar capsule, and within a little stone. This stone is encompassed with a white pulp, which has all the properties of true tallow, both as to consistence, colour, and even smell; and accordingly the Chinese make their candles of it; which would doubtless be as good as those in Europe, if they knew how to purify their vegetable, as well as we do our animal tallow. All the preparation they give it is, to melt it down, and to mix a little oil with it, to make it softer and more pliant. It is true their candles made of it yield a thicker smoke, and a dimmer light, than ours; but those defects are owing in a great measure to the wicks, which are not of cotton, but only a little rod of dry light wood, covered with the pith of a rush wound round it; which, being very porous, serves to filtrate the minute parts of the tallow, attracted by the burning stick, which, by this means, is kept alive. See Tomex.

TALPA, the *mole*, in natural history, a genus of Mammalia, of the order Feræ. Generic character: six fore-teeth in the upper jaw, unequal, eight in the lower; tusks solitary, in the upper jaw larger; seven grinders in the upper, and six in the lower. There are four species.

T. Europea, the European mole, is about six inches in length, without the tail. Its body is large and cylindrical, and its snout strong and cartilaginous. Its skin is of extraordinary thickness, and covered with a fur, short, but yielding to that of no other animal in fineness. It hears with particular acuteness, and, notwithstanding the popular opinion to the contrary, possesses eyes, which it is stated to be able to withdraw, or project, at pleasure. It lives partly on the roots of vegetables, but principally on animal food, such as worms and insects, and is extremely voracious and fierce. Shaw relates, from Sir Thomas Brown, that a mole, a toad, and a serpent, have been repeatedly inclosed in a large glass vase, and that the mole has not only killed the others, but has devoured a very considerable part of them. It abounds in soft ground, in which it can dig with ease, and which furnishes it with the greatest supply of food. It forms its subterraneous apartments with great facility by its snout and feet, and with a very judicious reference to escape and comfort. It produces four or five young in the spring, in a nest a little beneath the surface, composed of moss and herbage. It is an animal injurious to the grounds of the farmer, by throwing up innumerable hills of mould, in the construction of its habitation, or the pursuit of its food, and many persons in England obtain their subsistence from the premiums which are, on this account, given for their destruction. Moles can swim with considerable dexterity, and are thus furnished with the means of escape, in those sudden inundations to which they are frequently exposed. In Ireland, the mole is unknown. See Mammalia, Plate XX. fig. 5.

T. radiata, or the radiated mole, is very similar to the above, from which it is principally distinguished by a circle of radiated tendrils resembling the ray of a boot-spur, attached to the nose. It is a native of North America. See Mammalia, Plate XX. fig. 6.

The common mole of North America belongs to the genus Sorex: its specific name is Aquaticus.

TALUS, in fortification. Talus of a bastion, or rampart, is the slope or diminution allowed to such a work, whether it be of earth or stone, the better to support its weight. The exterior talus of a work, is its slope on the side towards the country, which is always made as little as possible, to prevent the enemy's scalade; unless the earth be bad, and then it is absolutely necessary to allow a considerable talus for its parapet. The interior talus of a work is its slope on the inside towards the place.

TAMARINDUS, in botany, *tamarind tree*, a genus of the Monadelphia Triandria class and order. Natural order of Lomentaceæ. Leguminosæ, Jussieu. Essential character: calyx four-parted; petals three; nectary of two short bristles under the filaments; legume pulpy. There is only one species, *viz.* T. indica, tamarind tree, which grows to a large size in those countries where it is a native; the stem is very large, covered

with a brown bark, dividing into many branches at the top, and spreading wide every way; the flowers come out from the side of the branches, five, six, or more together, in loose branches; the pods are thick and compressed; those from the West Indies are from two to five inches in length, containing two, three, or four seeds; those from the East Indies are nearly twice as long, and contain five, six, and even seven seeds; plants raised from both these are so much alike as not to be distinguished; the difference in the size of the pods is probably owing to soil and culture. The calyx is straw-coloured; the petals are yellowish, beautifully variegated with red veins; peduncles half an inch in length, each furnished with a joint, at which the flower turns inward; filaments commonly three; they are purple, and the anthers are brownish. The timber of the tamarind tree is heavy, firm, and hard; sawn into boards, it is converted to many useful purposes in building. The fruit is used both in food and medicine. In many parts of America, particularly in Curacao, they eat abundance of it raw, without any inconvenience. In Martinico also, they eat the unripe fruit, even of the most austere kind.

TAMARIX, in botany, *tamarisk*, a genus of the Pentandria Trigynia class and order. Natural order of Succulentæ. Portulaceæ, Jussieu. Essential character: calyx five-parted; petals five; capsule one-celled, three-valved; seeds pappose. There are four species: we shall notice the T. gallica, French tamarisk, which is a native of the south of France, Spain, Italy, Russia, Tartary, Barbary, and Japan, where it grows to a tree of a middling size; in England it is rarely more than fourteen feet in height. The bark is rough, and of a dark brown colour; it sends out many slender branches, most of which spread out flat; hanging downwards at their ends; these are covered with a chesnut coloured bark, and garnished with very narrow, finely-divided leaves, of a bright green colour, having small leaves or indentures, which lie over each other like scales of fish; the flowers are produced in taper spikes, at the end of the branches, several of them growing on the same branches; the spikes are about an inch long; the flowers are set very close all round the spike; they are small, and have five concave petals, of a pale flesh colour, with five slender stamina, terminated by roundish red anthers; the flowers appear in July, and are succeeded by oblong, acute-pointed, three-cornered capsules, filled with small downy seeds, which seldom ripen in England.

TAMBAC, a mixture of gold and copper, which the people of Siam hold more beautiful, and set a greater value on, than gold itself.

TAMBOUR, in architecture, a term applied to the Corinthian and Composite capitals, as bearing some resemblance to a drum, which the French call tambour.

TAMBOUR is also used for a little box of timber-work, covered with a ceiling, within side the porch of certain churches, both to prevent the view of persons passing by, and to keep off the wind, &c. by means of folding doors.

TAMUS, in botany, *black bryony*, a genus of the Dioecia Hexandria class and order. Natural order of Sarmentaceæ. Asparagi, Jussieu. Essential character: calyx six-parted; corolla none; female, style trifid; berry three-celled, inferior; seeds two. There are two species, *viz.* T. communis, common black bryony, and T. cretica, Creton black bryony.

TANACETUM, in botany, *tansey*, a genus of the Syngenesia Polygamia Superflua class and order. Natural order of Compositæ Discoidæ. Corymbiferæ, Jussieu. Essential character: calyx imbricate, hemispherical; corolla rays obsolete, trifid, sometimes none, and all the flowers hermaphrodite; down submarginate: receptacle naked. There are nine species, of which the T. vulgare, common tansey, has a fibrous creeping root, which spreads to a great distance; the herb is bitter, possessing a strong aromatic smell. It is a native of Europe and Siberia, in high meadows and pastures, on the banks of rivers, and in swampy places, flowering from June to August.

TANAECIUM, in botany, a genus of the Didynamia Angiospermia class and order: Essential character: calyx cylindrical, truncate; corolla tubular, almost equal, five-cleft; rudiment of a fifth filament; berry corticose, very large. There are two species, *viz.* T. jaroba, and T. parasiticum, both natives of Jamaica.

TANAGRA, the *tanager*, in natural history, a genus of birds of the order Passeres. Generic character: bill conic, somewhat inclining towards the point; upper mandible slightly ridged and notched near the end. There are forty-four species, of which the following deserve the chief attention.

T. jacapa, or the red-breasted tanager,

is of the size of a sparrow, and abounds in various parts of America. It feeds on fruits, and frequents gardens. Its nest is of a cylindrical form, fixed to the horizontal branch of a tree, and the entrance is beneath. It is generally seen in pairs.

The T. tatoa, or titmouse of Paradise, is nearly as large as a goldfinch, is one of the most beautiful birds of the genus, adorned with the most brilliant plumage of scarlet, blue, green, and gold. It is found in flocks in Cayenne and Guiana, at the season when a particular, but undescribed, fruit tree is in bearing, and is said to be found, in those countries, only in the immediate vicinity of these trees. It may be confined, and fed on bread and milk; but has no powers of melody.

TANGENT, in geometry, is defined, in general, to be a right line, which touches any arch of a curve, in such a manner, that no right line can be drawn between the right line and the arch, or within the angle that is formed by them. The tangent of an arch is a right line drawn perpendicularly from the end of a diameter, passing to one extremity of the arch, and terminated by a right line drawn from the centre through the other end of the arch, and called the secant. And the co-tangent of an arch is the tangent of the complement of that arch. The tangent of a curve is a right line, which only touches the curve in one point, but does not cut it.

In order to illustrate the method of drawing tangents to curves, let A C G, Plate XIV. Miscel. fig. 10, be a curve of any kind, and C the given point from whence the tangent is to be drawn. Then conceive a right line, $m\,g$, to be carried along uniformly, parallel to itself, from A towards Q; and let, at the same time, a point, p, so move in that line, as to describe the given curve, A C G; also let $m\,m$, or C n, express the fluxion of A m, or the velocity wherewith the line, $m\,g$, is carried; and let n S express the corresponding fluxion of $m\,p$, in the position m C g, or the velocity of the point, p, in the line, $m\;g$: moreover, through the point, C, let the right line, S F, be drawn, meeting the axis of the curve, A Q, in F.

Now it is evident, that if the motion of p, along the line $m\;g$, was to become equable at C, the point, p, would be at S, when the line itself had got into the position m S g; because, by the hypothesis, C n and n S express the distances that might be described by the two uniform motions in the same time. And if $w\;s\;g$ be assumed to represent any other position of that line, and s the contemporary position of the point, p, still supposing an equable velocity of p; then the distances, C v, and $v\;s$, gone over in the same time by the two motions, will always be to each other as the velocities, or as C n to n S. Therefore, since C v : $v\;s$ :: C n : n S, (which is a known property of similar triangles), the point, s, will always fall in the right line, F C S, (fig. 11): whence it appears, that if the motion of the point, p, along the line, $m\;g$, was to become uniform at C, that point would then move in the right line, C S, instead of the curve line, C G. Now, seeing the motion of p, in the description of curves, must either be an accelerated or retarded one; let it be first considered as an accelerated one, in which case, the arch, C G, will fall wholly above the right line, C D, as in fig. 10; because the distance of the point, p, from the axis A Q, at the end of any given time, is greater than it would be if the acceleration was to cease at C; and if the acceleration had ceased at C, the point, p, would have been always found in the said right line, F S. But if the motion of the point, p, be a retarded one, it will appear, by arguing in the same manner, that the arch C G, will fall wholly below the right line, C D, as in fig. 11.

This being the case, let the line $m\;g$, and the point p, along that line, be now supposed to move back again, towards A and m, in the same manner they proceeded from thence; then, since the velocity of p did before increase, it must now, on the contrary, decrease; and therefore, as p, at the end of a given time, after repassing the point, C, is not so near to A Q, as it would have been, had the velocity continued the same as at C, the arch, C h (as well as C G) must fall wholly above the right line, F C D: and by the same method of arguing, the arch, C h, in the second case, will fall wholly below F C D. Therefore F C D, in both cases, is a tangent to the curve at the point, C; whence the triangles, F m C, and C n S, being similar, it appears that the subtangent, m F, is always a fourth proportional to n S, the fluxion of the ordinate, C n, the fluxion of the absciss, and C m, the ordinate; that is, S n : n G :: m C : m F. Hence, if the absciss, A $m = x$, and the ordinate $m\,p = y$, we shall have $m\,\mathrm{F} = \frac{y\dot{x}}{\dot{y}}$; by means of which general expression, and the equation expressing the relation between x and y, the ratio of the fluxions, $\dot{x}$ and $\dot{y}$ will be found, and from thence the length of the sub-tangent, m F, as in the following examples.

1. To draw a right line C T, a tangent to a given circle, (fig. 12) B C A, in a given point, C. Let C S be perpendicular to the diameter, A B, and put A B $= a$, B S $= x$, and S C $= y$. Then, by the property of the circle, y^2 ($=$ C S^2) $=$ B S $\times$ A S ($= x \times \overline{a - x}$) $= a\,x - x^2$; whereof the fluxion being taken, in order to determine the ratio of $\dot{x}$ and $\dot{y}$, we get $2\,y\,\dot{y} = a\,\dot{x} - 2\,x\,\dot{x}$; consequently $\frac{\dot{x}}{\dot{y}} = \frac{2\,y}{a - 2\,x} = \frac{y}{\frac{1}{2}a - x}$; which multiplied by y, gives $\frac{y\,\dot{x}}{\dot{y}} = \frac{y}{\frac{1}{2}a - x} =$ the sub-tangent, S T. Whence, O, being supposed the centre, we have O S ($= \frac{1}{2}\,a - x$) : C S ($= y$) :: C S ($= y$) : S T; which is also found to be the case from other principles.

2. To draw a tangent to any given point, C, (fig. 13) of the conical parabola, A C G. If the *latus rectum* of the curve be denoted by a, the ordinate M C, by y, and its corresponding absciss, A M, by x; then the known equation, expressing the relation of x and y, being $a\,x = y^2$, we have, in this case, the fluxion $a\,\dot{x} = 2\,y\,\dot{y}$; whence $\frac{\dot{x}}{\dot{y}} = \frac{2\,y}{a}$; and consequently, $\frac{y\,\dot{x}}{\dot{y}} = \frac{2\,y^2}{a} = \frac{2\,a\,x}{a}, = 2\,x =$ M F. Therefore the sub-tangent is just the double of its corresponding absciss, A M. And so for finding the tangents of other species of curves.

TANNING, the art of manufacturing leather from raw hides and skins. Before we detail the process, it may be proper to observe, that raw hides and skins being composed of minute fibres intersecting each other in every direction, the general operation of tanning consists chiefly in expanding the pores, and dissolving a sort of greasy substance contained in them; and then, by means of the astringency and gummy resinous properties of oak bark, to fill and re-unite them, so as to give firmness and durability to the whole texture. But this theory has been controverted by some chemists, who suppose that the animal jelly contained in the skin is not dissolved, but unites during the process with the astringent principle of the bark, and forms a combination insoluble in water.

The process of tanning varies considerably, not only in different countries, but even in different parts of the same country. The following is the method most approved and practised in London and its vicinity. The leather consists chiefly of three sorts, known by the name of butts or backs, hides, and skins. Butts are generally made from the stoutest and heaviest ox hides, and are managed as follows: After the horns are taken off, the hides are laid smooth in heaps for one or two days in the summer, and for five or six in the winter: they are then hung on poles, in a close room called a smoke-house, in which is kept a smouldering fire of wet tan; this occasions a small degree of putrefaction, by which means the hair is easily got off, by spreading the hide on a sort of wooden horse or beam, and scraping it with a crooked knife. The hair being taken off, the hide is thrown into a pit or pool of water to cleanse it from the dirt, &c. which being done, the hide is again spread on the wooden beam, and the grease, loose flesh, extraneous filth, &c. carefully scrubbed out or taken off; the hides are then put into a pit of strong liquor called ooze or wooze, prepared in pits called letches or taps kept for the purpose, by infusing ground bark in water; this is termed colouring: after which they are removed into another pit called a scowering, which consists of water strongly impregnated with vitriolic acid, or with a vegetable acid prepared from rye or barley. This operation (which is called raising,) by distending the pores of the hides, occasions them more readily to imbibe the ooze, the effect of which is to astringe and condense the fibres, and give firmness to the leather. The hides are then taken out of the scowering, and spread smooth in a pit commonly filled with water, called a binder, with a quantity of ground bark strewed between each.

After lying a month or six weeks, they are taken up; and the decayed bark and liquor being drawn out of the pit, it is filled again with strong ooze, when they are put in as before, with bark between each hide. They now lie two or three months, at the expiration of which the same operation is repeated; they then remain four or five months, when they again undergo the same process; and after being three months in the last pit, are completely tanned, unless the hides are so remarkably stout as to want an additional pit or layer.

The whole process requires from eleven to eighteen months, and sometimes two years, according to the substance of the hide, and discretion of the tanner. When taken out of the pit to be dried, they are hung on poles; and after being compress-

ed by a steel pin, and beat out smooth by wooden hammers called beetles, the operation is complete; and when thoroughly dry, they are fit for sale. Butts are chiefly used for the soles of stout shoes. The leather which goes under the denomination of hides is generally made from cow hides, or the lighter ox hides, which are thus managed. After the horns are taken off, and the hides washed, they are put into a pit of water saturated with lime, where they remain a few days, when they are taken out, and the hair scraped off on a wooden beam, as before described; they are then washed in a pit or pool of water, and the loose flesh, &c. being taken off, they are removed into a pit of weak ooze, where they are taken up and put down (which is technically termed handling) two or three times a day for the first week: every second or third day they are shifted into a pit of fresh ooze, somewhat stronger than the former; till, at the end of a month or six weeks, they are put into a strong ooze, in which they are handled once or twice a week with fresh bark for two or three months. They are then removed into another pit, called a layer, in which they are laid smooth, with bark ground very fine, strewed between each hide. After remaining here two or three months, they are generally taken up, when the ooze is drawn out, and the hides put in again with fresh ooze and fresh bark; where, after lying two or three months more, they are completely tanned, except a few very stout hides, which may require an extra layer: they are then taken out, hung on poles, and being hammered and smoothed by a steel pin, are, when dry, fit for sale. These hides are called crop hides; they are from ten to eighteen months in tanning, and are used for the soles of shoes.

Skins is the general term for the skins of calves, seals, hogs, dogs, &c. These, after being washed in water, are put into lime-pits, as before mentioned, where they are taken up and put down every third or fourth day, for a fortnight or three weeks, in order to dilate the pores and dissolve the gelatinous parts of the skin. The hair is then scraped off, and the flesh and excrescences being removed, they are put into a pit of water impregnated with pigeon-dung (called a grainer or mastring,) forming a strong alkaline ley, which, in a week or ten days, soaking out the lime, grease, and saponaceous matter (during which period they are several times scraped over with a crooked knife to work out the dirt and filth), softens the skins, and prepares them for the reception of the ooze. They are then put into a pit of weak ooze, in the same manner as the hides, and being frequently handled, are by degrees removed into a stronger and still stronger liquor, for a month or six weeks, when they are put into a very strong ooze, with fresh bark ground very fine; and at the end of two or three months, according to the substance, are sufficiently tanned; when they are taken out, hung on poles, dried, and fit for sale. These skins are afterwards dressed and blacked by the currier; and are used for the upper-leathers of shoes, boots, &c. The lighter sort of hides, called dressing hides, as well as horse hides, are managed nearly in the same manner as skins; and are used for coach-work, harness-work, &c.

Having given some account of the process, as commonly used in this country, we proceed to one recommended by M. Seguin in France, who is supposed to have done much towards simplifying and rendering perfect the art. In order to give currency to the knowledge which he had obtained by a long course of experiments and actual practice in the business, he exhibited without reserve all that he had discovered, and at the same time actually executed his processes on the large scale, furnishing gratuitously skins and tan, in order that others who were witnesses to his plans might repeat for themselves, and at their leisure, the experiments they had seen him go through. We shall give an outline of his plan and reasoning on this important subject.

Skins swell up, and become soft, by moisture, which renders them permeable to water. Hence they are easily destroyed by the putrid process which ensues, and they become dry and brittle when the moisture is evaporated. Accident, no doubt, occasioned the discovery of the means of preventing these inconveniences by the use of certain vegetable substances, particularly the bark of oak. It was seen that skins prepared with these substances acquired new properties; that, without losing their flexibility, they became less permeable to water, more firm, more compact, and in some measure incapable of putrefaction. These observations gave birth to the art of the tanner. This art, no doubt of high antiquity, because founded on one of the earliest wants of man in society, comprehends a succession of processes which was executed by habit

and imitation, without a knowledge of the essential objects. The preparation of skins accordingly required several years, and frequently, in spite of the care, expense, and slowness of the operation, the tanning was incomplete; the skin formed a soft and porous leather, which was soon destroyed by moisture. These defects essentially sprung from ignorance of the true principles of this operation, because no discovery had been made respecting the action of tan upon the skin, and the circumstances, or conditions, which might accelerate or retard the process.

To arrive at this knowledge in an accurate manner, it is necessary to consider, first, the nature and properties of tan; and secondly, the structure and composition of the skin. We shall not enter into the detail of such precautions as are requisite in the choice of oak bark, the time and manner of separating it from the tree, preserving it, or pulverising it. It will be sufficient for our object to remark, that water poured into a vessel upon tan acquires, after some hours infusion, at the common temperature of the atmosphere, a brown colour, an astringent taste, and becomes charged with the most soluble substances contained in the tan; that by drawing off the water, and adding a similar quantity to the tan repeatedly, the whole of the soluble parts may be successively extracted, the water ceases to acquire colour, and there remains in the tub a mere fibrous matter or parenchymatous texture, insoluble in water, and no longer adapted to promote the operation of tanning. This residue is therefore always rejected in the manufactories as useless. It is only used by gardeners for their hot-beds, but might probably be advantageously applied in the fabrication of coarse paper.

It is therefore in the water of infusion, or the lixiviations of tan, that we must seek for the soluble substances which alone are efficacious in tanning. On examination of the water of the last filtration, it is found to be not only clearer, less impregnated, and less acrid than the water of the first lixiviation, but likewise that it possesses all the properties of the gallic acid. It reddens the infusion of tournsol, acts upon metallic solutions, and more particularly it precipitates a black fecula from sulphate of iron, &c. And it is also found, that a piece of fresh skin, divested of its fat and sanguine humours, and macerated in this liqour, instead of becoming compact, is softened and swells up.

The liquor of the first lixiviation exhibits a very different character. It is more coloured and astringent; it not only exhibits the properties of the gallic acid, by the alterations it causes in the blue colours of vegetables, and the black precipitate it forms with the sulphate of iron; but it likewise possesses the remarkable quality of forming, with animal gelatine, or glue, a yellowish abundant precipitate, insoluble in water, not putrescible, which becomes hard and brittle by drying; and if a piece of skin properly prepared be immersed in this fluid, it becomes gradually more compact, and is converted into leather.

There exist, therefore, in the same fluid, two very different substances: the one, which precipitates a black matter from iron, is the gallic acid or principle; the other, which precipitates animal gelatine or glue, is called the tanning principle, on account of its efficacy in the preparation of leather.

To leave no doubt on this important point, it was proved, by a number of experiments easy to be repeated. 1. That the liquor of the last lixiviation, though coloured, and of an astringent taste, affords no precipitate with glue; a fact, which seems to show that the gallic acid contained in the bark is less soluble than the tanning principle. In fact, as has already been remarked, when water is successively poured on the tan, an infusion is at last obtained, which no longer precipitates glue, though it precipitates sulphate of iron very well. 2. The liquor of the first lixiviation, after having been saturated with glue or animal gelatine, and forming an abundant precipitate with that substance, is entirely deprived of the tanning principle. It no longer differs from the liquor of the last filtrations, and contains merely a portion of the gallic acid. Hence the addition of sulphate of iron affords a new precipitate with this liquor. 3. As the tanning principle has a strong attraction to the animal gelatine, with which it always forms an insoluble precipitate, this property affords a very convenient re-agent to ascertain its presence immediately in any fluid, and to determine with precision its quantity. Accordingly, the infusion of tan poured into milk, whey, serum, broth, &c. forms, with these liquors, a precipitate more or less abundant, according to the quantity of gelatine they contain.

This peculiar property of the tanning principle affords an application, which

may become of great importance in the art of treating diseases, to determine the nature of urine, and to ascertain some of its changes. In the healthy subject, all whose functions are duly exercised, the urine does not contain gelatine, nor afford a precipitate with the infusion of tan: on the contrary, in all the gastric affections, the urine is more or less charged with gelatine; and forms, with the infusion of tan, a precipitate more or less abundant. The same observation is applicable to acute and chronical diseases, in which the assimilating or digestive forces are troubled, deranged, or perverted. 4. The gallic acid, or, if other terms be preferred, the principle which precipitates the sulphate of iron, is often found alone, or at least without being accompanied by the tanning principle. Thus, quinquina, crude or torrefied coffee, the roots of the strawberry-plant, scrofularia, milfoil, arnica, the flowers of Roman camomile, and all the multitude of plants vaguely comprised under the title of astringents, contain the gallic acid only. All these form with the sulphate of iron a precipitate more or less coloured and abundant; but none of them produce the slightest change in the solution of animal glue. On the contrary, the tanning principle has never been found alone, but always united or combined with the gallic principle. It was long supposed to exist exclusively in the oak, the nut-gall, and sumac, the only substances used at the tan-works; but it is found more or less abundantly in the siliquastrum, the rose-tree, the larix, several species of pines, the acacias, the lotus, the squill, the roots of bistort, of rhubarb, of parella, and several other plants. We have also found this principle in the products of distillation of different vegetable substances, where it was in some measure formed during the operation.

From these different considerations, founded on experiment, the following general principles may be deduced: 1. Every substance of which the infusion is capable of precipitating animal jelly, possesses the tanning property. 2. Every substance which possesses the tanning property, likewise precipitates the sulphate of iron black. 3. Every substance which precipitates the sulphate of iron, but not the solution of glue, does not possess the tanning property.

Upon M. Seguin's principle, a patent was some years since taken out by Mr. W. Desmond, who obtains the tanning principle by digesting oak-bark, or other proper material, in cold water, in an apparatus nearly similar to that used in the salt-petre works. That is to say, the water which has remained upon the powdered bark for a certain time, in one vessel, is drawn off by a cock, and poured upon fresh tan. This is again to be drawn off, and poured upon other fresh tan; and in this way the process is to be continued to the fifth vessel. The liquor is then highly coloured, and marks, as Mr. Desmond says, from six to eight degrees on the hydrometer for salts. He calls this the tanning lixivium. The criterion to distinguish its presence is, that it precipitates glue from its aqueous solution, and is also useful to examine how far other vegetable substances, as well as oak-bark, may be suitable to the purpose of tanning. The strong tanning liquor is to be kept by itself. It is found, by trials with the glue, that the tanning principle of the first digester which receives the clear water is, of course, first exhausted; but the same tan will still give a certain portion of the astringent principle, or gallic lixivium, to water. The presence of this principle is ascertained by its striking a black colour when added to a small quantity of the solution of vitriol of iron, or green copperas. As soon as the water from the digester ceases to exhibit this sign, the tan is exhausted, and must be replaced with new. The gallic lixivium is reserved for the purpose of taking the hair off from hides. Strong hides, after washing, cleaning, and fleshing, in the usual way, are to be immersed for two or three days in a mixture of gallic lixivium, and a thousandth part, by measure, of dense vitriolic acid. By this means the hair is detached from the hides, so that it may be scraped off with a round knife. When swelling or raising is required, the hides are to be immersed for ten or twelve hours in another vat, filled with water, and one five hundredth part of the same vitriolic acid. The hides being then repeatedly washed and dressed, are ready for tanning; for which purpose they are to be immersed for some hours in a weak tanning lixivium, of only one or two degrees; to obtain which, the latter portions of the infusions are set apart, or else some of that which has been partly exhausted by use in tanning. The hides are then to be put into a stronger lixivium, where, in a few days, they will be brought to the same degree of saturation with the liquor in which they are immersed. The strength of the liquor

will by this means be considerably diminished, and must therefore be renewed. When the hides are by this means completely saturated, that is to say, perfectly tanned, they are to be removed, and slowly dried in the shade. Calf-skins, goat-skins, and the like, are to be steeped in lime-water, after the usual fleshing and washing. These are to remain in the lime-water, which contains more lime than it can dissolve, and requires to be stirred several times a-day. After two or three days, the skins are to be removed, and perfectly cleared of their lime by washing and pressing in water. The tanning process is then to be accomplished in the same manner as for the strong hides; but the lixivium must be considerably weaker. Mr. Desmond remarks, that lime is used, instead of the gallic lixivium, for such hides as are required to have a close grain; because the acid mixed with that lixivium always swells the skins more or less: but that it cannot, with the same convenience, be used with thick skins, on account of the considerable labour required to clear them of the lime; any part of which, if left, would render them harsh, and liable to crack. He recommends, likewise, as the best method to bring the whole surface of the hides in contact with the lixivium, that they should be suspended vertically in the fluid, by means of transverse rods or bars, at such a distance as not to touch each other. By this practice, much of the labour of turning and handling may be saved. Mr. Desmond concludes his specification by observing, that in some cases it will be expedient to mix fresh tan with the lixivium; and that various modifications of strength, and other circumstances, will present themselves to the operator. He affirms that, in addition to the great saving of time and labour in this method, the leather, being more completely tanned, will weigh heavier, wear better, and be less susceptible of moisture, than leather tanned in the usual way; that cords, ropes, and cables, made of hemp or speartery, impregnated with the tanning principle, will support much greater weights without breaking, be less liable to be worn out by friction, and will run more smoothly on pullies; insomuch that, in his opinion, it will render the use of tar in many cases, particularly in the rigging of ships, unnecessary; and, lastly, that it may be substituted for the preservation of animal food instead of salt. The intelligent manufacturer will readily perceive, that this new method is grounded on two particular circumstances, besides a more scientific management of the general process than has been usual. The first consists in the method of determining the presence and quantity of the tanning principle by the hydrometer, and the precipitation of glue: the second in applying this principle, in a concentrated state, more early in point of time than has, perhaps, been hitherto done. Our tanners, after the common previous processes, and unhairing by acids, by lime, or by piling the hides, that they may heat and begin to putrify, apply the solution of tan, which they call ooze, in a great number of pits in the tan-yard. They begin with the weakest solution which has been used, and is of a lighter colour than the other; and they pass the hides, according to their judgment and experience, into oozes which are stronger and stronger; until at last, in certain cases, the hides come to be buried, for a certain time, in a solid mass of tan, or oak-bark. The oak-bark itself, in the pits, is not only the source from which the water extracts the tanning principle, but seems, likewise, in some measure, during the last stages of the process, to operate mechanically, by keeping the surfaces of the hides from touching each other.

TANTALITE, in mineralogy, a metallic fossil of an iron black colour on the external surface, but internally between bluish-grey and iron-black. It occurs imbedded, in masses of the size of a hazel nut, which have a tendency to the octahedral form. Externally it is smooth and glimmering; internally it is shining, and its lustre metallic. Specific gravity is 7.95. Its constituent parts are, tantalium, iron, and manganese. It is found imbedded in quartz, in Sweden; its name is derived from the new metal denominated TANTALIUM, which see.

TANTALIUM, a metal discovered by M. Ekeberg, in the mineral just mentioned; and in another named Ytrotantalite. From each he extracted by means of the fixed alkalies a white powder, which he ascertained to be the oxide of a peculiar metal; to this he gave the name of tantalium. When this oxide is powerfully heated with charcoal, it yields a button moderately hard, which, externally, has a metallic lustre, but internally it is black, and without any degree of brilliancy. The acids will reduce it again to an oxide, but they will not dissolve it. It melts before the blow-pipe with borax, or phosphate of soda, but gives no colour to either of them. Its specific gravity is about 6.5.

TANTALUS, the *ibis*, in natural history, a genus of birds of the order Grallæ. Generic character: bill long; thick at the base, incurvated; face naked, and sometimes all the head; tongue broad and short; nostrils linear and oval; four toes, connected by a membrane at the base. There are nineteen species, of which we shall notice the following: T. loculator, the wood ibis, is of the size of a goose, and the length of three feet, and is found in Carolina, and in many countries of South America, haunting, particularly, those low tracts which are inundated during summer. These birds subsist on reptiles and fish, have little sagacity, and are often seen in cypress trees of extraordinary height, with their heavy bills reposing on their breasts. They are in use for the table, though far from being excellent.

T. ruber, or the scarlet ibis, is found in America, and the neighbouring islands. Its plumage is of a most ardent scarlet, and it is one of the most beautiful birds of the genus. It subsists on insects, and the ova of fishes, for which, on the ebbing of the tide, it frequents the shores. It perches in trees, but lays its eggs on the ground. The old birds and the young keep in distinct flocks. They do not attain the full lustre and glow of plumage till their third year; and in sickness and confinement lose almost all their brilliancy.

T. ibis, or the Egyptian ibis, is more than three feet long, and as large as a stork. On the retreating of the Nile, it is found in Lower Egypt in great numbers, subsisting on insects and frogs. It perches on palm trees, and sleeps in an erect attitude, its tail touching its legs. It is supposed by some naturalists to be the ibis of the ancients, and is known to destroy and devour serpents. Others suppose it to be the ox-bird described by Shaw. For the blackheaded ibis, see Aves, Plate XIV. fig. 2.

TANTALUS's *cup*, in hydraulics, a siphon, so adapted to a cup, that the short leg being in the cup, the long leg may go down through the bottom of it.

The bended siphon is called Tantalus's cup, from the resemblance of the experiment made with an image in the glass, representing Tantalus in the fable, fixed up in the middle of the cup, with a siphon concealed in his body, beginning in the bottom of his feet, and ascending to the upper part of his breast; there it makes a turn, and descends through the other leg, on which he stands; and from thence down through the bottom of the cup, where it runs out, and causes the water to subside in the cup; as soon as it rises to the height of the siphon, or to the chin of the image, the water will begin to run through the siphon concealed in the figure, till the cup is emptied in the manner explained under siphon, and represented more distinctly in the article HYDRAULICS.

TAPE *worm*. See TÆNIA.

TAPESTRY. It has been supposed that the use of tapestry was introduced into the various nations of Europe from the Levant, by the princes and nobles who commanded in the different crusades undertaken to recover the Holy Land from the Saracens; but this supposition seems in a great measure to rest on the fact, that the workmen employed in this pursuit in France were called Sarrassinois. We do not find, upon referring to the travels of Bertrandon de la Brocquiere to Palestine, in 1432, any thing to support the assertion, neither do our modern tourists mention tapestry as used by the present inhabitants of that country. Lempriere describes the apartments of the Harem at Morocco to have been hung with rich damasks; but as the same rooms had European mirrors on the walls, it does not appear quite clear that the hangings were not introduced by the same means.

There is not a doubt that the Greeks used tapestry, as Homer frequently mentions the labours of the loom in a manner that proves the production of it could have been employed in no other way. Those countries which are subject to long and cold winters, made it necessary that the rich and powerful should adopt some method to check its disagreeable effects on domestic comfort; and besides, the feudal system universally prevailing, their residences were calculated for military purposes only: and every consideration of internal convenience was sacrificed to the means of defence from their jealous and envious neighbours of the same rank in the state; hence they constructed their mansions with walls as solid and impenetrable as those of a fortified city, in which the windows were little better than loop-holes for missive weapons externally, whence they were widened inwards to make the most of the little light and air they were capable of admitting.

Cold and dreary as all their apartments were, every possible contrivance was made to temper the damp chill of the walls; for this purpose vast fire places were constructed, occupying almost one

side of the square, and hangings were suspended to exclude from view the rough surface of the massy stones, and to confine the humidity in them from immediately attaching to the family. That which may have been used in Greece, in Palestine, and throughout Asia, for the double purposes of ornament, and for the convenience of easy removal during the warmth prevailing in those countries, where tapestry or hangings make the most pleasant partitions or separations of apartments, became necessary in the greatest part of Europe through a directly opposite cause.

Whatever was the nature of the original hangings in our quarter of the globe, and wherever they were introduced from, it is very certain that the French have had the honour of giving them their present denomination, which is derived from tapisser, to line, and that from the Latin tapes. It is very probable that the tapestry of ancient times in England, and on the Continent, was equally rude and barbarous with the paintings of the same period, and perhaps more so; and in the present state of the country it is difficult to ascertain when it improved, or when attempts were made to introduce figures in the weaving of it. When the feudal system ceased, our castles and castellated mansions were gradually deserted, and their possessors, mixing more with the general population, began to admire the comforts of society, and to adopt some of the customs of those they had hitherto despised; hence occurred a new mode of building, which, though it in some degree resembled that of their ancestors, was attended with infinite improvement. It is in the residences thus produced that we are now to look for the tapestry once so necessary, but in the latter instance preserved through a laudable family pride, and as objects of curiosity. At Hardwicke Hall in Derbyshire, one of the seats of the Duke of Devonshire, built by a Countess of Shrewsbury, in the reign of Queen Elizabeth, some very interesting tapestry and hangings of a bed are shown, which were worked by Mary, Queen of France and Scotland, during her long confinement at that place, previously to her execution. As may be anticipated, from her mode of faith, and the circumstances of her situation, the colours and subjects are of a sombre and melancholy cast, but sufficiently well done to excite approbation.

Those it will be remembered are the product of the needle, and are therefore very different from that which adorns the walls of the House of Lords from the loom, and are nearly coeval with the performances of the royal captive; the latter have long been celebrated as the only representations we possess of the destruction of the Spanish Armada, but their age and the fading of their colours have greatly lessened their interest. Exclusive of those, there are specimens of ancient tapestry at the Charter House, placed there by the Duke of Norfolk in the reign of Elizabeth, and at St. James's Palace, which is the best in every particular of all that has been mentioned.

It will be perceived, that in each of these instances the dates nearly correspond, whence it may be safely concluded, that very little use was made of tapestry after the reign of James I. in England. Next to the English, the Flemings were most expert at weaving of rich hangings; the French, who subsequently exceeded all other nations in this art, did not apply themselves to it till the reign of their Henry IV. when an establishment was made in the year 1607 in the Fauxbourg St. Michael at Paris; after the assassination of that monarch, the manufactory was neglected, nor was it revived till the reign of Louis XIV. under the auspices of Colbert, who caused a receptacle for this work to be constructed, where two brothers named Giles and John Gobelins, had long before been celebrated as excellent dyers, whence the name, which an edict issued by Louis, confirmed under the title of Hotel Royal des Gobelins. As it was the intention of the luxurious monarch just mentioned to excel all his contemporary sovereigns of Europe in the splendour of his palaces and establishments, the manufactory of the Gobelins was placed by him under a complete system of government, and it flourished, with some fluctuations of neglect and encouragement, as a royal institution, till the late revolution, during which dreadful period it was consigned, to all appearance, to irretrievable ruin; but the subsequent consulship of Bonaparte, and his further elevation to the throne of France, has in a great degree recovered it, though the change in public opinion in the manner of decorating walls will prevent it from obtaining its pristine encouragement.

The reader will forgive our enlarging on this subject, as the Gobelins is the only manufactory of tapestry remaining in Europe worthy of particular notice, and where paintings are imitated with all

the strength and beauty of colouring of the pictures from which they are copied. M. Le Maistre, who visited Paris in 1802, mentions two pieces made about that time, one representing the assassination of Admiral Coligni, and the other the heroic conduct of the President Molé, of uncommon excellence. Ninety persons were then employed, and appeared to work with the utmost ease, though six years apprenticeship and much attention and care are required to attain superior skill. Previously to the change in the government of France, the workmen were in a great degree state prisoners, but such is the jealousy of rivalship, that they are still under the special care or surveillance of the police; and the pieces manufactured were destined principally to ornament the favourite residence of St. Cloud, and some other public buildings. To this information we shall subjoin the still more recent account of Mr. Pinkerton in 1805. "In the ancient method," says that gentleman, "the workmen were obliged to stoop, which was found detrimental to their health, and the pictures were destroyed, being cut in pieces in the width of the loom; the figures were also reversed. Neilson, an intelligent foreman, contrived to save the pictures, in tracing them with oil-paper. Nor were the figures reversed as before, and the picture itself was placed behind the workman, that he might accurately express the shades and tone of colour. Still the result could not be judged of, till each division was perfected in the loom. Vaucanson superadded an easy and ingenious mechanism, to examine with pleasure the progress of the work; but the manufacture continued to be guided by a servile routine."

The last director introduced three improvements, which cannot very well be explained, but the result has been of great advantage in the manner of weaving; and as more judgment has been evinced in the selection of pictures for copying, the style of colouring partakes more of the taste of each master than when it was the custom to make all the tints vivid and gaudy; besides, as they have ceased to use silk, the tapestry is much less subject to fade. "Yet," adds Mr. Pinkerton, "the colours are sufficiently bright and various to represent, with exquisite truth, all the fine tints of beautiful flowers. It is however to be regretted that these splendid tapestries become so expensive, from the length of time required in the workmanship, that even the rich tremble; and the sale to the government, which presents them to distinguished foreigners, affords the chief if not sole consumption. The sum annually allowed, to support the manufacture in its greatest activity, is estimated at one hundred and fifty thousand francs."

As it is not in our power to obtain the precise improvements made in the manner of weaving tapestry, we are compelled to describe the mode by which that now remaining in England was made, and which is undoubtedly the basis of the present method in use at the Gobelins. The loom employed for this purpose stands perpendicularly, and is composed of four principal pieces, two of which are long planks, and the others rollers or beams of considerable diameter; the planks are placed upright, and the beams cross them at either extremity of the loom, the lower at about twelve inches from the floor; each have trunnions which suspend them on the planks, and they are turned with bars. The rollers are grooved lengthways, in which are fastened long cylinders of wood with hooks; the use of these is to fasten the ends of the warp to, the latter of twisted woollen thread encircles the upper roller, and it is worked as fast as wove on the lower.

The planks already mentioned are seven or eight feet in height, from fourteen to fifteen inches broad, and three or more in thickness; their interior surfaces are pierced into holes the whole length, for the admission of thick pieces of iron with hooks at their ends, which are intended to support what is called the coat-stave; those irons are also pierced to receive pins, by which the stave is contracted or expanded at pleasure. The coat-stave, three inches in diameter, extends the whole length of the loom, and on it are fixed the coats or threads, and thus the threads to the warp cross each other, in this particular having nearly the same effect with the spring-stave and treddles in the common looms. The coats, as they are called, are threads fastened to each thread of the warp by a sliding knot; those keep the warp open, and thus the broaches bearing the material for weaving are passed freely through, according to the will of the workman; besides, the process is further facilitated by small pieces of wood, which are used to make the thread of the warp intersect each other, and that those may keep their due situation, a packthread is run among the threads above the stick.

We will now suppose the loom prepared with the warp, the operator then proceeds to sketch the principal outline on the threads composing it from the picture or design to be copied, and this is done by placing the painting, or a cartoon, on the back of the intended tapestry, and tracing it with a black-lead pencil; after accomplishing the transfer, the original is rolled on a cylinder, and placed behind the workman, who unrolls it in the same progression with which he weaves. Exclusive of the instruments already mentioned, a broach, a reed, and an iron needle, are required for introducing the silk or wool of the woof amongst the threads of the warp; the first is about two-thirds of an inch thick, and seven or eight inches in length, terminating at one extremity in a point, with the other formed into a kind of handle, and is made of hard wood; this broach, as it is termed, serves as a shuttle, the silk, wool, gold, or silver thread, being wound on it. The reed is a kind of comb, made of wood, eight or more inches in length, and an inch thick at the back, tapering thence to the teeth, which vary in their distance from each other, according to the fineness of the tapestry. The needle varies from the common instrument of that name only in its size, and its use is to press the material close in those parts where any defect is observed. The most singular part of the weaving of tapestry is the position of the weaver, who works on the wrong side of the piece, and with his back to the picture he is to imitate; consequently, he is frequently compelled to leave his position and pass to the opposite side of the loom, to ascertain whether he has been correct in his proceedings. When he is about to put the material in the warp, he turns and examines the original; then having furnished the broach with the colour required, he introduces it amongst the threads of the warp, which he brings across each other with his fingers, through the assistance of the coats or threads secured to the staff, and this operation is repeated with every change of tint. After the wool or silk is placed, he presses it close with the reed or comb, and examining the picture, he makes the necessary amendments with the needle. Those subjects which are very large may be worked upon by more than one weaver at a time. The method we have described is called the high warp; another, the low warp; though rather different in the manner of weaving it, so nearly resembles the tapestry of the high warp, that it is unnecessary to describe it.

TAPIR, in natural history, a genus of Mammalia of the order Belluæ. Generic character: ten fore teeth in each jaw; tusks in both jaws single and incurvated; five grinders on each side in both jaws; feet with three hoofs, and on the fore feet a false hoof. The only species is the T. Americanus. This is a native of South America, and, when perfect in growth, is about the size of a heifer. Its colour is a dark brown, and the male is distinguished by a species of very short proboscis. The tapir is perfectly inoffensive, and considerably timid, seeking safety in flight, and often plunging into waters, in which he swims with great rapidity, and in which sometimes he proceeds for a long way, ranging at the bottom at a very great depth; in this respect resembling the hippopotamus. When resting, the tapir sits in the manner of a dog. In feeding, its trunk is employed in drawing into its mouth the vegetables which constitute its nourishment. In some parts of Guiana it has been domesticated, and, when taken young, is easily familiarized. Its flesh is not excellent for flavour or delicacy, but is nevertheless used for food; and its skin, which is of uncommon toughness, is converted to various purposes of usefulness. It is slow in its movements, sleeps during the greater part of the day, and is destroyed by the Indians, who decoy it by the imitation of its peculiar sounds, by poisoned arrows. It produces but one at a birth, in the care of which it is extremely assiduous and affectionate.

TAR, a thick, black, unctuous substance, obtained from old pines and fir trees, by burning them with a close smothering heat: it is used for coating and caulking ships, &c. and various other purposes.

TARANTULA. See Aranea.

TARCHONANTHUS, in botany, African *flea-bane*, a genus of the Syngenesia Polygamia Æqualis class and order. Natural order of Nucamentaceæ. Corymbiferæ, Jussieu. Essential character: calyx one-leafed, commonly half seven-cleft, turbinate; seeds covered with down; receptacle villose. There are three species: these plants are all natives of the Cape of Good Hope.

TARE, is an allowance for the outside package, that contains such goods as cannot be unpacked without detriment, or for the papers, threads, bands, &c. that inclose or bind any goods imported loose;

or, though imported in casks, chests, &c. yet cannot be unpacked and weighed net. Several sorts of goods have their tares ascertained, and those are not to be altered or deviated from, in any case, within the port of London, unless the merchant, thinking himself, or the officers of the crown, to be prejudiced by such tares, shall desire that the goods may be unpacked, and the net-weight taken; which may be done either by weighing the goods in each respective cask, &c. net, or, (as is practised in East India goods particularly) by picking out several casks, &c. of each size, and making an average, compute the rest accordingly. But this must not be done without the consent of two surveyors, attested by their hands in the land-waiter's books; and in the out-ports, not without the consent of the collector and surveyor. And as to those goods which have not their tares ascertained, two surveyors in London, and the collector and surveyor in the out-ports are to adjust and allow the same, in like manner. Sometimes the casks, &c. are weighed beyond sea, before the goods are put in; and the weight of each respective cask, &c. marked thereon (as is usual for most goods imported from the British plantations,) or else inserted in the merchant's invoice; in which case, if the real invoice be produced, and the officers have satisfied themselves (by unpacking and weighing some of them) that those weights are just and true, they do then, after having reduced them to British weight, esteem them to be the real tares, and pass them accordingly. But the unpacking goods, and taking the net weight, being supposed the justest method, both for the crown and merchant, it is usually practised in the port of London, in all cases where it can be done with conveniency, and without detriment to the goods.

TARGIONIA, in botany, so named, in honour of Cypriani Targioni, M. D. of Florence, a genus of the Cryptogamia Hepaticæ. Generic character: calyx two-valved, compressed, containing at bottom a capsule nearly globular, many-seeded. There is only one species; *viz.* T. hypophylla, a native of Italy, Spain, Constantinople, Flanders; Saxony, about Dresden; and England, near Dawlish, in Devonshire; flowering from March to May.

TARTARIC *acid*, in chemistry, was procured by Scheele in a separate state in the year 1770. The process which he followed was by boiling a quantity of the substance called tartar, or cream of tartar, in water, and adding powdered chalk till effervescence ceased, and the liquid no longer reddened vegetable blues. It was then allowed to cool, the liquor filtered, and a white insoluble powder remained on the filter, which was carefully removed and well washed. This was put into a matrass, and a quantity of sulphuric acid, equal in weight to the chalk employed, diluted with water, poured upon it. The mixture was allowed to digest for twelve hours on a sand bath, stirring it occasionally with a glass rod. The sulphuric acid combined with the lime, and formed a sulphate of lime, which fell to the bottom. The liquid contained the tartaric acid dissolved in it. This was decanted off, and a little acetate of lead dropped into it, as a test to detect the sulphuric acid, should any remain; and if this be the case, it must be digested again with more tartrate of lime, to carry off what remains of the sulphuric acid. It is then to be evaporated, and about one-third of the weight of the tartar employed is obtained of concrete tartaric acid. To purify this, the crystals may be dissolved in distilled water, and again evaporated and crystallized. It seems probable that this acid exists in a state of purity in some vegetables. Vauquelin found a 64th part in the pulp of the tamarind. Tartaric (or tartarous) acid thus obtained, is in the form of very fine needle-shaped crystals; but they have been differently described by different chemists. According to Bergman, they are in the form of small plates, attached by one extremity, and diverging at the other. They have been found by others grouped together in the shape of needles, pyramids, regular six-sided prisms, and square and small rhomboidal plates. The specific gravity is 1.6. This acid has a very sharp, pungent taste; diluted with water, it resembles the taste of lemon juice; and it reddens strongly blue vegetable colours. When it is exposed to heat, on burning coals, it melts, blackens, emits fumes, froths up, and exhales a sharp pungent vapour. It then burns with a blue flame, and leaves behind a spongy mass of charcoal, in which some traces of lime have been detected. In the decomposition of the tartaric acid by heat, one of the most remarkable products which particularly characterizes it, is an acid liquor of a reddish colour, which amounts to one-fourth of the weight of the former. This was formerly known by the name of pyrotartarous acid. It

has a slightly acid taste, produces a disagreeable sensation on the tongue, is strongly empyreumatic, and reddens the tincture of turnsole. But it has been found, by the experiments of Fourcroy and Vauquelin, to be the acetic acid impregnated with an oil. Tartaric acid is very soluble in water. The specific gravity of a solution formed by Bergman, was found to be 1.2. This solution in water is not liable to spontaneous decomposition, unless it is diluted. While it is concentrated, it loses nothing of its acid nature or its other properties. According to the analysis of Fourcroy and Vauquelin, 100 parts of this acid are composed of

Oxygen	70.5
Carbon	19.0
Hydrogen	10.5
	100.0

Tartaric acid is not applied to any use, and but few of its combinations are employed in the practice of medicine.

TASTE, *sense of*. The senses of taste and smell are nearly allied to the sense of feeling; indeed they may be considered as modifications of feeling. They however are properly distinguished from it, because they have each a peculiar organ, and are each affected by peculiar properties of bodies. The chief organ of taste is the tongue; and it is fitted for its office by the numerous extremities of nerves which are lodged along its surface, and particularly at the top and sides. Hartley considers this sense as extending to the other parts of the mouth, down the throat, the stomach, and the other parts of the channel for food. Taken in this comprehensive sense, the sense of taste conveys to the mind sensations, not only of flavours, but of hunger and thirst.

In order to produce the sense of taste, the nervous extremities of the tongue must be moistened, and the action of eating generally produces an effusion of a fluid from different parts of the mouth, which answers the purpose of exciting the taste, and of assisting digestion. The pleasures derived from taste are very considerable; and the power of yielding pleasurable sensations accompanies the taste through the whole of life. Hence it is reasonable to infer, that the pleasures of taste constitute one grand source of the mental pleasures, that is, those which can be felt without the direct intervention of sensation. They leave their relics in the mind; and these combine together, with other pleasures, and thus form feelings which often connect themselves with objects which have no immediate connection with the objects of taste. To this source Hartley traces the principle origin of the social pleasures; and there cannot be a doubt that the pleasures of taste are the chief original sources of the filial affection. It appears that one end of the long continuance of the pleasures of taste is, to supply continual accessions of vividness to the mental pleasures; but doubtless the principal object is, to make that a source of pleasure, which is necessary for self-preservation. The pains of taste are much less numerous than those of feeling. They are only such as are necessary to prompt to avoid excessive abstinence or gratification, and to prevent the employment of improper food; and therefore depend much more upon causes which man usually has under his own controul.

TAUGHT, a term used in maritime business, to denote the state of being extended, or stretched out, and is usually applied in opposition to slack.

TAURUS, the *bull*, in zoology. See Bos.

TAURUS, in astronomy, one of the twelve signs of the zodiac, the second in order, consisting of forty-four stars, according to Ptolemy; of forty-one, according to Tycho; and of no less than one hundred and thirty-five, according to the Britannic catalogue.

TAWING, the art of dressing skins in white, so as to be fit for divers manufactures, particularly gloves, &c. All skins may be tawed; but those chiefly used for this purpose are lambs', sheep, kids', and goat skins.

TAXUS, in botany, *yew tree*, a genus of the Dioecia Monadelphia class and order. Natural order of Coniferæ. Essential character: male calyx none; corolla none; stamina many; anthers peltate, eight-cleft; female corolla none; style none; seed one, in a berried calycle that is quite entire. There are four species: we shall notice the T. haccata, common yew-tree, which has a straight trunk, with a smooth, deciduous bark; the wood is hard, tough, and of a fine grain; leaves thickly set, linear, smooth, ever green; flowers axillary, enveloped with imbricate bractes; the male on one tree, sulphur-coloured, without a calyx; the female on another, with a small green calyx, sustaining the oval flattish seed,

which calyx at length becomes red, soft, full of a sweet slimy pulp. The yew-tree is a native of Europe, North America, and Japan; its proper situation is in mountainous woods, or more particularly the clefts of high calcareous rocks. England formerly possessed great abundance, and it is now not very uncommon, in a wild state, in some parts of the country. Of planted trees there are yet several in church yards. Mr. Evelyn mentions a yew-tree in the church-yard of Crowhurst, in Surrey, which was ten yards in compass; another in Braburne church-yard, not far from Scot's Hall, in Kent, being fifty-eight feet eleven inches in circumference, or nearly twenty feet in diameter.

TEARS, a name for the limpid fluid secreted by the lachrymal glands, and flowing on the surface of the eye; either in consequence of local irritation, or the emotions of grief. Some part of this aqueous fluid is dissipated in the air; but the greatest part, after having performed its office, is propelled by the orbicular muscle, which so closely constringes the eyelid to the ball of the eye as to leave no space between, unless in the internal angle, where the tears are collected.

From this collection the tears are absorbed by the orifices of the punctæ lachrymaliæ; from thence they are propelled through the lachrymal canals into the lachrymal sac, and flow through the ductus nasalis into the cavity of the nostrils, under the inferior concha nasalis. The tears have no smell, but a saltish taste. The uses of the tears are these: 1. They continually moisten the surface of the eye and eye-lids, to prevent the transparent cornea from drying and becoming opaque, or the eye from concreting with the eyelids. 2. They prevent that pain which would otherwise arise from the friction of the eye-lids against the ball of the eye from continually winking. 3. They wash away dust, or any thing acrid, that may have fallen into the eye. This liquid is transparent and colourless, has no perceptible smell, but a saline taste. It communicates to vegetable blues a permanent green colour. When it is evaporated nearly to dryness, cubic crystals are formed, which are muriate of soda. Soda is in excess, because vegetable blues are converted by it to a green colour. A portion of mucilaginous matter, which becomes yellow as it dries, remains after the evaporation. This liquid is soluble in water, and in alkalies. Alcohol produces a white flaky precipitate, and when it is evaporated, muriate of soda and soda remain behind. By burning the residuum, some traces of phosphate of lime and of soda are detected. The component parts of tears are, therefore,

Water,	Muriate of soda,
Mucilage,	Phosphate of lime,
Soda,	Phosphate of soda.

The mucilage of tears absorbs oxygen from the atmosphere, and becomes thick, viscid, and of a yellow colour. It is then insoluble in water. Oxymuriatic acid produces a similar effect. It is converted into muriatic acid, so that it has been deprived of its oxygen. The mucus of the nose consists of the same substances as the tears; but being more exposed to the air, it acquires a greater degree of viscidity from the mucilage absorbing oxygen.

TECHNICAL, expresses somewhat relating to arts or sciences; in this sense we say technical terms. It is also particularly applied to a kind of verses, wherein are contained the rules or precepts of any art, thus digested to help the memory to retain them; an example whereof may be seen in the article MEMORY.

TECTONA, in botany, a genus of the Pentandria Monogynia class and order. Natural order of Vitices, Jussieu. Essential character: corolla five-cleft; stigma toothed; drupe dry, spongy, within the inflated calyx; nut three-celled. There is only one species; *viz.* T. grandis, teak wood, or Indian oak; the trunk of this tree grows to an immense size; bark ash-coloured; branches cross-armed, numerous, spreading; young shoots four-sided; leaves opposite, above scabrous, beneath covered with soft white down; the leaves on young trees from twelve to twenty-four inches long, and from eight to sixteen broad; petiole short, thick, laterally compressed; panicle terminating, very large, cross-armed; divisions dichotomous, with a sessile fertile flower in each cleft: the whole covered with a hoary farinaceous substance; flowers small, white, very numerous, fragrant; nectary very small; nut exceedingly hard, four-celled. It is a native of the large forests in Java and Ceylon, Malabar, Coromandel, Pegu, Ava, the confines of Cochinchina, and Cambodia, &c. The wood of this tree has by long experience been found to be the most useful timber in Asia; it is light, easily worked, and at the same time both strong and durable; for ship building the teak is reckoned superior to any other sort

of wood. A durable vessel of burthen cannot be built in the river of Bengal, without the aid of teak plank; some of the finest merchant ships ever seen on the river Thames have arrived from Calcutta, where they were built of teak timber.

TEETH. See ANATOMY. Teeth have been analyzed by Mr. Pepys, who has found the constituent parts of teeth of different ages to be, in different proportions, phosphate of lime, carbonate of lime, and cartilage.

According to Fourcroy and Vauquelin, the enamel is composed of

Phosphate of lime . .	72.9
Gelatine and water . .	27.1
	100

TELEGRAPH, a word derived from the Greek, and which is very properly given to an instrument, by means of which information may be almost instantaneously conveyed to a considerable distance. The telegraph, though it has been generally known and used by the moderns only for a few years, is by no means a modern invention. There is reason to believe, that amongst the Greeks there was some sort of telegraph in use. The burning of Troy was certainly known in Greece very soon after it happened, and before any person had returned from thence. Now that was altogether so tedious a piece of business, that conjecture never could have supplied the place of information. A Greek play begins with a scene in which a watchman descends from the top of a tower in Greece, and gives the information that Troy was taken. "I have been looking out these ten years (says he) to see when that would happen, and this night it is done." Of the antiquity of a mode of conveying intelligence quickly, to a great distance, this is certainly a proof. The Chinese, when they send couriers on the great canal, or when any great man travels there, make signals, by fire, from one day's journey to another, to have every thing prepared; and most of the barbarous nations used formerly to give the alarm of war by fires lighted on the hills or rising grounds.

It does not appear that the moderns had thought of such a machine as a telegraph, till the year 1663, when the Marquis of Worcester, in his "Century of Inventions," affirmed that he had discovered "a method by which, at a window, as far as eye can discover black from white, a man may hold discourse with his correspondent, without noise made or notice taken; being according to occasion given, or means afforded, *ex re nata*, and no need of provision before hand; though much better if foreseen, and course taken by mutual consent of parties." This could be done only by means of a telegraph, which, in the next sentence, is declared to have been rendered so perfect, that by means of it the correspondence could be carried on "by night as well as by day, though as dark as pitch is black."

About forty years afterwards, M. Amontons proposed a new telegraph. His method was this: Let there be people placed in several stations, at such a distance from one another, that, by the help of a telescope, a man in one station may see a signal made in the next before him; he must immediately make the same signal, that it may be seen by persons in the station next after him, who are to communicate it to those in the following station, and so on. These signals may be as letters of the alphabet, or as a cypher, understood only by the two persons who are in the distant places, and not by those who make the signals. The person in the second station making the signal to the person in the third the very moment he sees it in the first, the news may be carried to the greatest distance in as little time as is necessary to make the signals in the first station. The distance of the several stations, which must be as few as possible, is measured by the reach of a telescope. Amontons tried this method in a small tract of land, before several persons of the highest rank at the court of France. It was not, however, till the French revolution that the telegraph was applied to useful purposes.

Whether M. Chappe, who is said to have invented the telegraph first used by the French about the end of 1793, knew any thing of Amonton's invention or not, it is impossible to say; but his telegraph was constructed on principles nearly similar. The manner of using this telegraph was as follows: At the first station, which was on the roof of the palace of the Louvre at Paris, M. Chappe, the inventor, received in writing from the Committee of Public Welfare, the words to be sent to Lisle, near which the French army at that time was. An upright post was erected on the Louvre, at the top of which were two transverse arms, moveable in all directions by a single piece of

mechanism, and with inconceivable rapidity. He invented a number of positions for these arms, which stood as signs for the letters of the alphabet; and these, for the greater celerity and simplicity, he reduced in number as much as possible. The grammarian will easily conceive that sixteen signs may amply supply all the letters of the alphabet, since some letters may be omitted, not only without detriment, but with advantage. These signs, as they were arbitrary, could be changed every week; so that the sign of B for one day might be the sign of M the next; and it was only necessary that the persons at the extremities should know the key. The intermediate operators were only instructed generally in these sixteen signals; which were so distinct, so marked, so different the one from the other, that they were easily remembered.

The construction of the machine was such, that each signal was uniformly given in precisely the same manner at all times: It did not depend on the operator's manual skill; and the position of the arm could never, for any one signal, be a degree higher or a degree lower, its movement being regulated mechanically. M. Chappe having received at the Louvre the sentence to be conveyed, gave a known signal to the second station, which was Mont Martre, to prepare. At each station there was a watch tower, where telescopes were fixed, and the person on watch gave the signal of preparation which he had received, and this communicated successively through all the line, which brought them all into a state of readiness. The person at Mont Martre then received, letter by letter, the sentence from the Louvre, which he repeated with his own machine; and this was again repeated from the next height, with inconceivable rapidity, to the final station at Lisle.

Various experiments were in consequence tried upon telegraphs in this country; and one was soon after set up by government, in a chain of stations from the Admiralty office to the sea-coast. It consists of six octagon boards, each of which is poised upon an axis in a frame, in such a manner that it can be either placed vertically, so as to appear with its full size to the observer at the nearest station, or it becomes invisible to him by being placed horizontally, so that the narrow edge alone is exposed, which narrow edge is from a distance invisible. Six boards make thirty-six changes, by the most plain and simple mode of working; and they will make many more, if more were necessary: but as the real superiority of the telegraph, over all other modes of making signals, consists in its making letters, we do not think that more changes than the letters of the alphabet, and the arithmetical figures, are necessary; but, on the contrary, that those who work the telegraphs should avoid communicating by words or signs agreed upon to express sentences; for that is the sure method never to become expert at sending unexpected intelligence accurately. This telegraph is, without doubt, made up of the best number of combinations possible; five boards would be insufficient, and seven would be useless. It has been objected to it, however, that its form is too clumsy to admit of its being raised to any considerable height above the building on which it stands; and that it cannot be made to change its direction, and consequently cannot be seen but from one particular point. Several other telegraphs have been proposed to remedy these defects, and perhaps others to which the instrument is still liable. The dial-plate of a clock would make an excellent telegraph, as it might exhibit one hundred and forty-four signs, so as to be visible at a great distance. A telegraph on this principle, with only six divisions instead of twelve, would be simple and cheap, and might be raised twenty or thirty feet high above the building without any difficulty: it might be supported on one post, and therefore turn round; and the contrast of colours would always be the same.

TELESCOPE, an optical instrument, which is used for discovering and viewing distant objects, either directly by glasses, or by reflection. Telescopes are either refracting or reflecting; the former consist of different lenses, through which the objects are seen by rays refracted by them to the eye; and the latter, of specula, from which the rays are reflected and passed to the eye. The lens, or glass, turned to the object, is called the object glass; and that next the eye, the eye-glass; and when the telescope consists of more than two lenses, all but that next the object are called eye-glasses.

The principal effects of telescopes depend upon this maxim, "that objects appear larger in proportion to the angles which they subtend at the eye: and the effect is the same, whether the pencils of rays, by which objects are visible to us, come directly from the objects them-

selves, or from any place nearer to the eye, where they may have been united, so as to form an image of the object; because they issue again from those points in certain directions, in the same manner as they did from the corresponding points in the objects themselves. In fact, therefore, all that is effected by a telescope is, first to make such an image of a distant object, by means of a lens or mirror, and then to give the eye some assistance for viewing that image as near as possible; so that the angle which it shall subtend at the eye may be very large, compared with the angle which the object itself would subtend in the same situation. This is done by means of an eye-glass, which so refracts the pencils of rays, as that they may afterwards be brought to their several foci, by the natural humours of the eye. But if the eye had been so formed as to be able to see the image with sufficient distinctness, at the same distance, without an eye-glass, it would appear to him as much magnified, as it does to another person who makes use of a glass for that purpose, though he would not, in all cases, have so large a field of view.

Although no image be actually formed by the foci of the pencil without the eye, yet if, by the help of an eye-glass, the pencils of rays shall enter the pupil, just as they would have done from any place without the eye, the visual angle will be the same as if an image had been actually formed in that place.

Telescopes are of several kinds, distinguished by the number and form of their lenses, or glasses, and denominated from their particular uses, &c. such are the "terrestrial, or land telescope," the "celestial, or astronomical telescope;" to which may be added, the "Galilean, or Dutch telescope," the "reflecting telescope;" the achromatic telescope," &c.

We shall proceed to describe some of these, in order to illustrate the principle.

The "astronomical telescope" consists of two convex lenses, A B, K M, Plate XVI. Miscel. fig. 1. fixed at the two extremities of a tube, that consists, at least, of two parts, that slide one within the other, for adjusting the focus in proportion to the distance of the objects that are to be seen through the telescope.

P Q represents the semi-diameter of a very distant object, from every point of which rays come, so very little diverging to the object lens, K M, of the telescope, as to be nearly parallel: *p q* is the picture of the object, P Q, which would be formed upon a screen situated at that place: Beyond that place, the rays of every single radiant point proceed divergingly upon another lens, A B, called the eye-glass, which is more convex than the former, and are, by this, caused to proceed parallel to one another, in which direction they enter the eye of the observer at O.

The two lenses of this telescope have a common axis, O L Q; L *q* is the focal distance of the object lens, and E *q* is the focal distance of the eye lens. An object viewed through this telescope, by an eye situated at O, will appear distinct, inverted, and magnified; *viz.* the object seen without the telescope will be, to its appearance through the telescope, as *q* E to *q* L; that is, as the focal distance of the eye lens to the focal distance of the object lens. For the rays, see Optics, which, after their crossing at the place, *r q p*, proceed divergingly, fall upon the lens, A B, in the same manner as if a real object were situated at *r q p*; and, of course, on the other side of that lens the rays of each pencil will proceed parallel. Now to the eye at O, the apparent magnitude of the object, or of the part, P Q, is measured by the angle, E O A, or by its equal, *q* E *p*; but to the naked eye at L, when the glass is removed, the apparent magnitude of the object is measured by the angle, Q L P, or by its equal, *q* L *p*; therefore the apparent magnitude, to the naked eye, is to the apparent magnitude through the telescope, as the angle, *q* L *p*, is to the angle, *q* E *p*; or as the distance, *q* E, is to the distance, *q* L. This telescope is mostly used for astronomical observations; for, as it inverts the object, the representation of terrestrial objects through it would not be pleasant. It is evident, from the above explanation, that if the two lenses of this telescope have equal focal distances, the telescope will not magnify. It also appears, that, with a given object lens, the shorter the focus of the eye lens is, the greater will the magnifying power be. But when the disproportion of the two focal lengths is very great, then the aberration, arising from the figure of the lenses, and from the dispersive power of glass, becomes so very great as to do more damage than can be compensated by the increased magnifying power. Hence, in order to obtain a very great magnifying power, those telescopes have sometimes been made very long, as, for instance, of 100 feet, or upwards: and as they were used for astronomical pur-

poses, or mostly in the night time, they were frequently used without a tube, *viz.* the object lens was fixed on the top of a pole, in a frame capable of motion in any required direction, and the eye lens was fixed in a short tube that was held in the hand of the observer. The distance, as well as the direction, of the two lenses, was adjusted by a strong cord stretched between the frame of the object lens and the tube of the eye lens. In this construction, the instrument has been called an "aërial telescope." Its use is evidently incommodious; but it was with such a telescope that five satellites of Saturn, and other remarkable objects, were discovered.

The object, which appears inverted through this telescope, will appear upright and distinct, if two more convex eye glasses be subjoined to it, at a distance from each other, which is equal to the sum of their focal distances; and when their focal distances are equal, the object will be magnified as much as without those additional glasses; but through them it will appear upright, and not inverted. Hence this telescope has been mostly used for viewing terrestrial objects, and is therefore called the "terrestrial telescope."

The "Galilean telescope" consists of a convex object lens, and a concave eye lens, and derives its name from the great Galileo, who is generally reckoned the inventor of it. Fig. 2 shows, that the distance between the two lenses is less than the focal distance of the object lens; *viz.* instead of the convex lens situated behind the place of the image, to make the rays of each pencil proceed in a parallel direction to the eye, here a concave eye lens is placed as much before that image; and this lens opens the rays of each pencil that converged to q and p, and makes them emerge parallel towards the eye; as is evident by conceiving the rays to go back again through the eye lens, whose focal distance is E q.

The eye must be placed close to the concave lens, in order to receive as many pencils as possible; and then supposing an emerging ray of an oblique pencil to be produced backwards along A O, the apparent magnitude of the object is measured by the angle, A O E, or its equal, q E p, which is to the angle, q L p, or Q L P, as q L to q E, *viz.* as in the astronomical telescope. It is evident, that in this telescope the objects appear erect, for the rays of light do not cross each other.

The field of view, or quantity of objects that are taken in at once in this telescope, does not depend upon the breadth of the eye lens, as in the astronomical telescope, but upon the breadth of the pupil of the eye; because the pupil is less than the eye lens, A B, and the lateral pencils do not now converge to, but diverge from, the axis of the lenses. Upon this account the view is narrower in this than in the preceding telescope; yet the objects through it appear remarkably clear and distinct.

"The night telescope" is a short telescope, *viz.* about two feet long, which represents the objects inverted, much enlightened, but not much magnified. Its field of view is also very extensive. This telescope, in consequence of those properties, is used at night mostly by navigators, for the purpose of discovering objects that are not very distant, but which cannot otherwise be seen, for want of sufficient light; such as vessels, coasts, rocks, &c. On account of its extensive field, and great light, this telescope has also been advantageously used, by astronomers, for discovering some celestial objects, whose situation was not exactly known, or for viewing at once the relative situation of several stars and other objects.

This telescope has a pretty large and simple object lens, whence it derives its great light; for as the rays which proceed from every single point of the object fall upon the whole lens of a telescope, and are thence refracted to a focus, it is evident that the larger that lens is, the greater number of rays will be thrown upon that focus, and of course the brighter will the image be. In this telescope, large lens may be used, because the telescope is not intended to magnify more than about four or six times in lineal extension.

Within this telescope a second lens is often used for shortening the focal length of the object lens. The eye lens is sometimes single, but mostly double, (*viz.* a combination of two plano-convex lenses placed at a little distance from each other) and pretty large: hence is derived the extensive field of view, which in some of those telescopes exceeds six or seven degrees.

We may observe, once for all, that in every telescope the distance between the object lens and the other lens or lenses must be alterable, in order that the focus may be adjusted according to the distance of the objects. Hence, every telescope

consists at least of two tubes, one of which, *viz.* that with the eye lenses, slides within the other. To the same telescope several eye tubes, with a shallower or deeper lens, or with a different number of lenses, may be adapted successively, in order to give them different magnifying powers, suitable to the clearness of the air, of the objects, &c. as also for converting them into astronomical or terrestrial telescopes.

We now proceed to the reflected telescope, which is likewise called the Newtonian telescope; for if not the original projector, Sir Isaac Newton is, at least, the first person who executed a telescope of this sort, which consists of reflecting and refracting parts.

The general principle of this telescope is the same as that of the dioptric or refracting telescope. In the latter, the rays which come from a distant object are, by the action of the convex object lens, collected to a focus, and beyond that focus the rays of every single radiant point are rendered again parallel by the action of the eye lens or eye lenses. This is otherwise expressed, by saying that the object lens forms an image of the object, which image is viewed by the eye lens. In the former, *viz.* in the reflecting telescope, the rays which come from a distant object are, by the action of a concave reflector, sent back convergingly to a focus, where they form an image, which is viewed through the eye lens. There are several varieties of this telescope; we shall content ourselves with the description of one only, *viz.* the Gregorian telescope, which is represented in fig. 3. The large concave speculum, B E, of this telescope, is perforated with a hole quite through its middle. Within the tube of the telescope, a small concave speculum, $x\,y$, is supported by the arm, H, directly facing the large speculum, B E. Two lenses, $w\,x$ and $n\,o$, are contained in the eye tube, and the observer applies his eye to a small hole at P, in order to view a magnified distant object.

The large reflector, B E, receives the rays, $a\,c$, $b\,d$, from the distant object, and reflects them to its focus, e, where they form the inverted image, or where they cross each other, and then fall divergingly upon the small reflector, $x\,y$, whose focus is at f; *viz.* a little further than the focus, e, of the large reflector: hence the rays are reflected back upon the lens, $w\,x$, not in a parallel, but in a converging manner; and that convergency is increased by the action of that lens, so as to come to a focus, or to form a second image, R S, much larger than the former, and erect like the object. Lastly, this image is viewed through the eye lens, $n\,o$; or, in other words, the rays from every single point of the object, after this second crossing, fall divergingly upon the eye lens, which sends them nearly parallel to the eye at P, through a very small hole. Sometimes the eye lens, $n\,o$, is double, *viz.* it consists of two lenses, which perform the office of a single lens.

If the first lens, $w\,x$, were removed, the image would be formed somewhat larger at z; but the area or field of view would be smaller and less pleasant. At the place of the image, R S, there is situated a circular piece of brass, called a diaphragm, with a hole of a proper size to circumscribe the image, and to cut off all superfluous or extraneous light, in order that the object may appear as distinct as possible.

The magnifying power of this telescope is computed in the following manner: If this telescope consisted of the two reflectors only, and these were situated so that e were the focus of each reflector; then the rays which came parallel from the distant object to the large reflector, and divergingly from that to the small reflector, would, after the second reflection, go parallel to the eye at P, and of course the object would appear magnified in the proportion of the focal distance of the large reflector to the focal distance of the small reflector; so that if the focal distance of the former be to that of the latter as six to one, then the object would be magnified six times in diameter. But since the first image is magnified into a second image much larger, which is viewed through the eye lens, therefore the whole magnifying power is in a proportion compounded of de to ex, and of zx, to zo. If the former proportion be as six to one, and the latter as eight to one, then the object will appear forty-eight (*viz.* six by eight) times larger in diameter through the telescope than to the naked eye.

The fourth species of reflecting telescope goes under the name of "Cassegrainian Telescope." It differs from the preceding, in having the small reflector convex, instead of concave; in consequence of which the small reflector must be placed nearer to the large reflector than the focus of the latter; then the rays from the large reflector fall convergingly upon the convex small reflector, and are by it sent back convergingly upon the lens, $w\,x$, &c. The chief difference be-

tween this and the preceding telescope is, that in this the object appears inverted, because in it there is no image formed, or the rays do not cross each other, between the two reflectors. Also with the same magnifying power, &c. this telescope is shorter than the Gregorian, by twice the focal length of the small speculum.

To both those telescopes a long wire is fixed all along the outside of the tube, at the end of which there is a screw which works into an external projection, *g*, of the internal arm, H, and serves to move that arm with the small speculum nearer to or further from the large speculum, in order to adjust the focus of the instrument, according to the distance of the object. The action of this wire is easily understood; for it passes through a hole at F, where it is prevented going forwards or backwards by two shoulders, which are indicated by the figure: hence, when the observer looks through the hole, P, he turns with his hand the wire by the nut, Q, which screws the projection, *g*, of the arm nearer or further, &c. until the object appears very distinct.

The largest reflecting telescope now existing, was constructed by that excellent astronomer, Dr. Herschel. Is is a telescope in which the observer looks through an eye lens down upon the large reflector, whose polished surface is forty-eight inches in diameter. Its focal length is about forty feet.

There are however two useful appendages to telescopes, which deserve to be briefly described. A finder, *viz.* a short telescope, A, fig. 3, is generally affixed to the tube of a large telescope, for the purpose of finding out an object expeditiously. This finder does not magnify the object more than four, six, or eight times; but it has a great field of view, so that through it a great part of the heavens may be seen at once. In the inside of its tube, and exactly at the focus of the eye glass, there are two slender wires, which cross each other in the axis of the telescope. Now the finder is adjusted by means of screws upon the tube of the great telescope, in such a manner as that when an object, seen through the finder, appears to be near the crossing of the above-mentioned wires, it is at the same time visible through the great telescope: hence, when the observer wishes to view a small distant object, as a star, a planet, &c. he moves the instrument to one side or the other, until, by looking through the finder, he brings the object nearly to coincide with the crossing of the wires; and when that takes place, he immediately looks through the large telescope, &c.

A micrometer is an instrument, which is used with a telescope, for the purpose of measuring small angles. A great variety of micrometers have been contrived by various ingenious persons; and they are more or less complicated, more or less expensive, as also more or less accurate. See MICROMETER.

"Achromatic Telescope," is a name given to the refracting telescope invented by Mr. John Dollond, and so contrived as to remedy the aberration arising from colours, or the different refrangibility of the rays of light. The improvement made by Mr. Dollond in his telescopes, by making two object-glasses of crown-glass, and one of flint, which was tried with success when concave eye-glasses were used, was completed by his son Peter Dollond; who, conceiving that the same method might be practised with success with convex eye glasses, found, after a few trials, that it might be done. Accordingly he finished an object glass of five feet focal length, with an aperture of 3¾ inches, composed of two convex lenses of crown-glass, and one concave of white flint glass. But apprehending afterward that the apertures might be admitted still larger, he completed one of 3½ feet focal length, with the same aperture of 3¾ inches. In the 17 inch improved achromatic telescope, the object glass is composed of three glasses, *viz.* two convex of crown-glass, and one concave of white flint-glass: the focal distance of this combined object-glass is about seventeen inches, and the diameter of the aperture two inches. There are four eye-glasses contained in the tube, to be used for land objects; the magnifying power with these is near fifty times; and they are adjusted to different sights, and to different distances of the object, by turning a finger screw at the end of the outer tube. There is another tube, containing two eye-glasses that magnify about seventy times, for astronomical purposes. The telescope may be directed to any object by turning two screws in the stand on which it is fixed, the one giving a vertical motion, and the other a horizontal one. The stand may be inclosed in the inside of the brass tube.

The object-glass of the 2½ and 3½ feet telescopes is composed of two glasses, one convex, of crown-glass, and the other concave, of white flint glass; and the diameters of their apertures are two inches and 2¾ inches. Each of them is furnished with two tubes; one for land objects,

containing four eye-glasses, and another with two eye-glasses for astronomical uses. They are adjusted by buttons on the outside of the wooden tube: and the vertical and horizontal motions are given by joints in the stands. The magnifying power of the least of these telescopes, with the eye-glass for land objects, is nearly fifty times, and with those for astronomical purposes, eighty times; and that of the greatest for land objects is nearly seventy times, but for astronomical observations eighty and a hundred and thirty times; for this has two tubes, either of which may be used as occasion requires This telescope is also moved by a screw and rack-work, and the screw is turned by means of a hook's joint.

We must now say something of the specula of telescopes, baving referred to this place from the article SPECULUM. The metals of reflecting telescopes are generally composed of thirty-two parts of copper and fifteen of grain tin, with the addition of two parts of arsenic, to render the composition more white and compact. It has been ascertained, by a variety of experiments, that if one part of brass, and one of silver, be added to this composition, and only one of arsenic used, a most excellent metal will be obtained, which is the whitest, bardest, and most reflective. The first composition is, however, for inexperienced persons, the best, as the easiest to cast, to grind, and polish. When this is employed, the copper and tin should be melted, and when mixed together should be poured into cold water, which will separate the mass into a number of small particles. These small pieces of metal are then to be collected and put into the crucible, along with the silver and brass: after they have been melted together in a separate crucible, the proper quantity of arsenic is to be added, and a little powdered rosin thrown into the crucible before the metal is poured into the flasks. For the particular methods of grinding and polishing, we refer to Brewster's edition of Ferguson's Mechanics, vol. i.

TELEPHIUM, in botany, a genus of the Pentandria Trigynia class and order. Natural order of Portulaceæ, Jussieu. Miscellaneæ, Linnæus. Essential character: calyx five-leaved; petals five, inserted into the receptacle; capsule one-celled, three-valved. There are two species, *viz.* T. imperati, true orpine; and T. oppositifolium, both natives of Barbary.

TELLER, an officer of the Exchequer, in ancient records called tallier: there are four of these officers, whose duty is to receive all sums due to the king, and to give the clerk of the pells a bill to charge him therewith. They likewise pay all money due from the king, by warrant from the auditor of the receipt, and make weekly and yearly books, both of their receipts and payments, which they deliver to the lord-treasurer.

TELLINA, in natural history, a genus of the Vermes Testacea class and order: animal a tethys: shell bivalve, generally sloping on one side; in the fore part of one valve a convex; of the other, a concave fold; hinge with usually three teeth, the lateral ones smooth, in one shell. There are about eighty species, divided into sections. A. ovate and thickish. B. ovate and compressed. C. suborbicular. We shall notice one or two only. T. gari: shell oval, with transverse recurved striæ; lateral teeth obsolete; it inhabits the Indian ocean: the fore part is inflected and very rough, with transverse wrinkles, crossed in the middle by perpendicular striæ; sometimes cinereous, with brown rays; sometimes bluish, spotted with white, and white and red rays. T. cornea: shell globular, glabrous, horn-colour, with a transverse groove. This Mr. Pennant has described in the British Zoology: it inhabits the ponds and fresh water of Europe: it is not larger than a pea. The shell is pellucid, very finely striate across; within bluish white; without white, or pale or bluish-ash, with transverse black curves, one of which is more distinct; lateral teeth of the hinge elongated, hardly any middle ones.

TELL-TALE, in music, a moveable piece of ivory, or lead, suspended in the front of a chamber-organ, on one side of the keys, by a string; one side of the keys being attached to the bellows within, rises as they sink, and apprizes the performer in what degree the wind is exhausted.

TELLURIUM. See SYLVAN.

TEMPERAMENT, in music, the accommodation or adjustment of the imperfect sounds, by transferring a part of their defects to the more perfect ones, in order to remedy, in some degree, the false intervals of those instruments, the sounds of which are fixed; as the organ, harpsichord, piano-forte, &c.

TEMPERING *of steel and iron*, the rendering them either more compact and hard, or soft and pliant, according as the different uses for which they are wanted may require.

The hardest steel is the most brittle;

but in many cases it is necessary to diminish the hardness, and this operation is called tempering. The greatest difficulty consists in applying the proper degree of heat uniformly over the whole mass. The common method is, to judge by the colour assumed by the clean surface of steel when thus heated. The heat may be applied by the fire, or a pan of charcoal, or the flame of a candle or lamp, or by laying the piece upon sand to be gradually heated, or upon melted lead. Saw-makers, and those who manufacture springs, heat the article, rub it with grease, and then heat it further till the fumes take fire; this is called blazing, and affords a temper nearly the same as when the steel, by heat, has acquired a deep blue colour. When the temper is given from the colour, the first tinge is a faint straw colour: this is suitable to pen-knives and hard cutting tools. The next colour, which is purple, is rather too soft for a knife, and too brittle for a spring. After this follows the blue, of which there are several shades: the deepest is very soft, and this succeeded by a whitish-yellow, which indicates too great a degree of softness for any cutting tool. Mr. Hartley took out a patent for a method of tempering steel, which was done by heating the tools in oil raised to a high temperature. Pen-knives require a heat of 450° of Fahrenheit.

TEMPLARS, or Templers, a religious order instituted at Jerusalem, about the year 1118. Some religious gentlemen put themselves under the government of the patriarch of Jerusalem, renounced property, made the vow of celibacy and obedience, and lived like canons regular. King Baldwin assigned them an apartment in his palace. They had likewise lands given them by the king, the patriarch, and the nobility, for their maintenance. At first there were but nine of this order, and the two principal persons were, Hugo de Paganis, and Geoffrey of St. Omers. About nine years after their institution, a rule was drawn up for them, and a white habit assigned them, by Pope Honorius II. About twenty years after this, in the popedom of Eugenius III. they had red crosses sewed upon their cloaks, as a mark of distinction; and in a short time they were increased to about three hundred, in their convent at Jerusalem. They took the names of Knights Templars, because their first house stood near the temple dedicated to our Saviour, at Jerusalem. This order, after having performed many great exploits against the infidels, became rich and powerful all over Europe; but the knights, abusing their wealth and credit, fell into great disorders and irregularities. Many crimes and enormities being alleged against them, they were prosecuted in France, Italy, and Spain; and at last, the pope, by his bull of the 22d of May, 1312, given in the council of Vienna, pronounced the extinction of the order of Templars, and united their estates to the order of St. John of Jerusalem.

TENACITY, a term applied to metals, by which is meant the power that a metallic wire, of a given diameter, has of resisting, without breaking, the action of a weight suspended from its extremity. The tenacity of different metals is very various: an iron wire, of one-tenth of an inch in diameter, will support, without breaking, about 5 cwt.; whereas one of lead will not support 30lb.

TENAILLE, in fortification, a kind of outwork, resembling a hornwork, but generally somewhat different; for, instead of two demi-bastions, it bears only in front a re-entering angle between the same wings, without flanks; and the sides are parallel. Tenaille, double or flanked, is a work whose front consists of four faces, making two re-entering angles, and three saliant; the wings or sides of this work being in like manner correspondent in the front of the gorge. Tenaille simple, a work having its front formed by two faces, which make a re-entering angle, the sides running directly parallel from the head to the gorge. Tenaille of the place, is that which is comprehended between the points of two neighbouring bastions; that is to say, the curtain, the two flanks that are raised on the curtain, and the two sides of the bastions which face one another; so that it is the same with what is otherwise called the face of the fortress. Tenaille of the foss, is a low work raised before the curtain in the middle of the foss: it is of three sorts; the first is composed of a curtain, two flanks, and two faces; the rampart of the curtain, including the parapet and talus, is but five fathom thick, but the rampart of the flanks and faces is seven. The second is composed only of two faces made on the lines of defence, whose rampart and faces are parallel. The third sort differs from the second only in this, that its rampart is parallel to the curtain of the place. All three sorts are good, and cannot be hurt by the besiegers' cannon, till they are masters of the covert way, and have planted their cannon there.

TENANT, signifies one who holds or possesses lands or tenements by any kind of right, either in fee, for life, years, or at will.

TENCH. See CYPRINUS.

TENDER, in law, is an offer to pay a debt, or perform a duty. This is often pleaded in an action as a bar to the plaintiff's recovery; and where the money demanded by the plaintiff has been tendered or offered to him before the commencement of the suit, and he has refused to accept it, the plaintiff is barred of his action and costs. In pleading a tender, the defendant says, the plaintiff ought not to have his action, because, except as to so much, specifying the sum, he owes nothing to the plaintiff; and as to that sum, he has been always ready and willing to pay it, and before the commencement of the suit tendered and offered it to the plaintiff, and that he refused it; which sum of money he of course brings into court, to be paid to the plaintiff, if he will accept the same; and this bringing money into court, on a plea of tender, is done without a special motion. In all other cases, the leave of the court must be had, before money can be brought into court. The rule under which this leave is granted is, as in the case of an ejectment by a mortgage, founded upon a particular act of parliament. In other cases it is founded upon the discretionary power vested in the court. By the discretionary rule it is sometimes ordered, that upon bringing money into court all proceedings in an action shall be stayed. At other times it is ordered, that the money brought into court shall be struck out of the plaintiff's declaration, and that the plaintiff shall not, at the trial of the issue, be permitted to give any evidence as to this money. This rule, by which the money brought into court is ordered to be struck out of the declaration, is from its being more frequently granted, than that by which it is ordered that the proceeding shall be stayed, called the common rule. Upon a plea of tender, the defendant must not plead the general issue, or a full denial as to the whole demand, but only to that part which is an excess above the sum tendered. And the plaintiff in answer to this must either deny the tender, or reply that there was a demand and refusal, which is a sufficient answer to the plea that states the defendant was always ready to pay. If bank notes have been offered, and no objection made on that account, it has been considered by the Court of King's Bench as good tender. But to constitute a tender, there must not merely be an offer by the defendant, that, if the plaintiff will take it, he will give him so much; but there must be an actual offer and readiness, accompanied with apparent ability, to pay immediately, although it is not absolutely necessary to produce the money in tale upon the table.

It is said a bank note is no tender, nor is it, if it is refused. But by a late statute, before any one can be arrested, and held to bail, the plaintiff must swear that his debt has not been tendered to him in bank notes, so that it is next to a legal tender; yet the plaintiff may sue by process, without holding to bail, and obtain judgment against the defendant, with his costs; on which the sheriff will levy, and probably tender the amount in bank notes; so that the plaintiff will be put off in an endless circle, if it is worth while to incur costs; and bank notes are now a legal tender in every thing but the name, which is, in the opinion of the best writers on political economy, a circumstance that must depreciate their real value.

TENDER, a small ship, in the service of men of war, for carrying of men, provisions, or any thing else that is necessary.

TENDONS. Membranes are those parts of the body which include some of the internal parts of animals. Many of them are extremely thin, and they possess different degrees of transparency. They become pulpy by maceration in water, and by boiling are almost entirely converted into gelatine, so that they are chiefly composed of this substance. No phosphate of lime, nor other saline matter, has been detected in the membranous substances hitherto analyzed. Tendons are reduced by boiling to a gelatinous substance, so that they are composed of a similar matter with membranes. The ligaments afford a portion of gelatine by boiling, but are not, like the two former, entirely reduced to jelly, so that some other substance besides gelatine enters into the composition of ligaments.

TENEBRIO, in natural history, a genus of insects of the order Coleoptera. Antennæ moniliform, the last joint roundish; thorax plano-convex, margined; head projecting; shells rigid. There are about one hundred species, divided into sections. A. Feelers six, filiform; foreshanks formed for digging. B. Feelers four. One of the most remarkable spe-

cies is T. mortisagus, which is black, and about an inch long; it is slow in its motions, and distinguished by the remarkably pointed appearance of the wing-sheaths, which at their extremities project a little beyond the abdomen. It is found in dark, neglected places, beneath boards in cellars; and if handled, and especially if crushed, it gives out a very unpleasant smell. T. gibbosus, or, according to Dr. Shaw, T. globosus, is seen during the hottest part of summer about walls and path-ways; it is distinguished by the globular appearance of the body. T. molitor, is an insect often found in houses, is coal black, and very small. It proceds from a larva called the meal-worm, from its being commonly found in meal and bread. This is said to be the favourite food of nightingales. It remains two years before it changes into a chrysalis. These three species are inhabitants of Europe; the latter has become naturalized in America.

TENEMENT, in its common acceptation, is applied only to houses and other buildings; but in its original, proper, and legal sense, it signifies every thing that may be holden, provided it be of a permanent nature, whether it be of a substantial or of an unsubstantial and ideal kind. Thus frank tenement, or freehold, is applicable not only to lands and other solid objects, but also to offices, rents, commons, and the like; and as lands and houses are tenements, so is an advowson a tenement; and a franchise or office, a right of common, a peerage, or other property of the like unsubstantial kind, are all of them, legally speaking, tenements.

TENESMUS, in medicine, a name given by medical writers to a complaint, which is a continual desire of going to stool, but without any stool being ready to be voided.

TENNE, Tenny, or Tawny, in heraldry, a bright colour made of red and yellow mixed; sometimes also called brusk, and expressed in engraving, by thwart or diagonal strokes or hatches, beginning from the sinister chief, like purpure, and marked with the letter T. In the coats of all below the degree of nobles, it is called tenny; but in those of nobles, it is called hyacinth; and in prince's coats, the dragon's head.

TENNIS, a play at which a ball is driven by a racket, which requires great practice to make a good player, so that nothing can be done without it; all we presume to do is, to give an insight into the game, by which a person may not seem a total stranger to it when he happens to be in a tennis court.

The game of tennis is played in most capital cities of Europe, particularly in France, whence we may venture to derive its origin. It is esteemed, with many, to be one of the most ancient games in Christendom, and long before King Charles I.'s time it was played in England. This game is as intricate as any game whatever; a person who is totally ignorant of it may look on for a month together, without being able to make out how the game is decided.

The size of a tennis-court is generally about 96 or 97 feet by 33 or 34, there being no exact dimension ascribed to its proportion, a foot more or less in length or width being of no consequence. A line or net hangs exactly across the middle, over which the ball must be struck, either with a racket or board, to make the stroke good. Upon the entrance of a tennis-court, there is a long gallery which goes to the dedans, that is, a kind of front gallery, where spectators usually stand; into which, whenever a ball is struck, it tells for a certain stroke. This long gallery is divided into different compartments or galleries, each of which has its particular name, as follows; from the line towards the dedans are the first gallery, door, second gallery, and the last gallery, which is called the service side. From the dedans to the last gallery are the figures 1, 2, 3, 4, 5, 6, at a yard distance each, by which the chaces are marked, and is one of the most essential parts of the game, as will appear in the following description.

On the other side of the line are also the first gallery, door, second gallery, and last gallery, which is called the hazard-side. Every ball struck into the last gallery on this side reckons for a certain stroke, the same as the dedans. Between the second and this last gallery are the figures 1, 2, to mark the chaces on the hazard-side. Over this long gallery, or these compartments, is a covering, called the penthouse, on which they play the ball from the service-side, in order to begin a set of tennis, from which it is called a service. When they miss putting the ball (so as to rebound from the penthouse) over a certain line on the service-side, it is deemed a fault, two of which are reckoned for a stroke. If the ball rolls round the penthouse, on the opposite of the court, so as to fall beyond a certain line described for that pur-

pose, it is called passe, reckons for nothing on either side, and the player must serve again.

On the right-hand side of the court from the dedans is what they call the tambour, a part of the wall which projects, and is so contrived in order to make a variety in the stroke, and render it more difficult to be returned by the adversary; for when a ball strikes the tambour, it varies its direction, and requires some extraordinary judgment to return it over the line. The last thing on the right-hand side is called the grill, wherein, if the ball is struck, it is also 15, or a certain stroke.

The game of tennis is played by what they call sets; a set of tennis consists of six games: but if they play what is called an advantage-set, two above five games must be won on one side or the other successively, in order to decide; or, if it comes to six games all, two games must still be won on one side to conclude the set; so that an advantage-set may last a considerable time; for which kind of sets the cour. is paid more than for any other.

We must now describe the use of the chaces, and by what means these chaces decide or interfere so much in the game. When the player gives his service at the beginning of a set, his adversary is supposed to return the ball; and wherever it falls after the first rebound untouched, the chace is called accordingly; for example, if the ball falls at the figure 1, the chace is called at a yard, that is to say, at a yard from the dedans: this chace remains till a second service is given; and if the player on the service-side lets the ball go after his adversary returns it, and if the ball falls on or between any of these figures or chaces, they must change sides, there being two chaces; and he who then will be on the hazard-side must play to win the first chace; which if he wins by striking the ball so as to fall, after its first rebound, nearer to the dedans than the figure 1, without his adversary's being able to return it from its first hop, he wins a stroke, and then proceeds in like manner to win the second chace, wherever it should happen to be. If a ball falls on the line with the first gallery door, second gallery, or last gallery, the chace is likewise called at such or such a place, naming the gallery-door, &c. When it is just put over the line, it is called a chace at the line. If the player on the service-side returns a ball with such force as to strike the wall on the hazard-side, so as to rebound after the first hop over the line, it is also called a chace at the line.

The chaces on the hazard-side proceed from the ball being returned either too hard or not quite hard enough; so that the ball after its first rebound falls on this side of the blue line, or line which describes the hazard-side chaces; in which case it is a chace at 1, 2, &c. provided there is no chace depending. When they change sides, the player, in order to win this chace, must put the ball over the line any where, so that his adversary does not return it. When there is no chace on the hazard-side, all balls put over the line from the service-side, without being returned, reckon for a stroke.

As the game depends chiefly upon the marking, it will be necessary to explain it, and to recommend those who play at tennis to have a good and unbiassed marker, for on him the whole set may depend: he can mark in favour of the one and against the other in such a manner, as will render it two to one at starting, though even players. Instead of which the marker should be very attentive to the chaces, and not be any way partial to either of the players.

This game is marked in a very singular manner, which makes it at first somewhat difficult to understand. The first stroke is called 15, the second 30, the third 40, and the fourth game, unless the players get four strokes each; in that case, instead of calling it 40 all, it is called deuce; after which, as soon as any stroke is got, it is called advantage; and in case the strokes become equal again, deuce again, till one or the other gets two strokes following, which win the game; and as the games are won, so they are marked and called; as one game love, two games to one, &c. towards the set, of which so many of these games it consists.

Although but one ball at a time is played with, a number of balls are made use of at this game to avoid trouble, and are handed to the players in baskets for that purpose; by which means they can play as long as they please, without ever having occasion to stoop for a ball.

TENON, in building, &c. the square end of a piece of wood, or metal, diminished by one third of its thickness, to be received into a hole in another piece, called a mortise, for the jointing or fastening the two together. It is made in various forms, square, dovetailed for double mortises, and the like.

TENOR, or TENORE, in music, the first mean or middle part, or that which is the ordinary pitch of the voice, when neither raised to a treble, or lowered to a bass. The tenor is commonly marked in thorough bass with the letter T. This is that part which almost all grown persons can sing; but as some have a greater compass of voice upwards, others downwards, others are confined to a kind of medium, and others can go equally high or low; hence musicians make a variety of tenors, as a low, a high, a mean, a natural tenor, to which may be added, a violin tenor, &c. for instruments.

TENSE, TIME, in grammar, an inflection of verbs, whereby they are made to signify or distinguish the circumstance of time, in what they affirm.

TENSION, the state of any thing stretched, as a line, &c. Thus animals sustain and move themselves by the tension of their muscles and nerves: a chord, or musical string, gives an acuter or deeper sound, as it is in a greater or less degree of tension, that is, more or less stretched.

TENT, in surgery, a roll of lint worked into the shape of a nail, with a broad flat head.

TENTER, a machine used in the cloth manufacture, to stretch out the pieces of cloth, stuff, &c. or only to make them even, and set them square. It is usually about four feet and a half high, and for length exceeds that of the longest piece of cloth. It consists of several long pieces of wood, placed like those which form the barriers of a manege; so that the lower cross piece of wood may be raised or lowered, as is found requisite, to be fixed at any height, by means of pins. Along the cross pieces, both the upper and under one, are hooked nails, called tenter hooks, driven in from space to space.

TENTHREDO, in natural history, *saw-fly*, a genus of insects of the order Hymenoptera: mouth with a horned curved mandible, toothed within, the jaw straight and obtuse at the lip, the lip cylindrical bifid; four feelers, unequal filiform; wings tumid, the lower ones less; sting composed of two serrate laminæ, and almost secreted. There are about one hundred and fifty species, in divisions, distinguished by the antennæ. A. antennæ clavate; B. antennæ inarticulate, thicker at the tip; C. antennæ pectinate; in D, they are filiform, with from seven to nine articulations; in E, they are filiform, with numerous articulations. The larvæ of the insects of this genus feed on the leaves of various plants; the female uses her sting in the manner of a saw, hence the common name. It cuts out spaces in the twigs or buds of trees, for the purpose of depositing her eggs. The larvæ resemble those of the order Lepidoptera, or real caterpillars, from which they may be distinguished by their more numerous feet, which are never fewer than sixteen, though they are sometimes found with as many as twenty-eight. It feeds on the leaves of plants, and when touched, rolls itself up spirally. The pupa is folliculate; the eggs increase in size every day till the larvæ burst from them. The larvæ of the smaller species are often injurious to different kinds of esculent vegetables.

TENURE, the manner whereby lands or tenements are holden, or the service that the tenant owes to his lord. Under the word tenure is included every holding of an inheritance; but the signification of this word, which is a very extensive one, is usually restrained by coupling other words with it; this is sometimes done by words, which denote the duration of the tenant's estate: as if a man hold to himself and his heirs, it is called tenure in fee-simple. At other times the tenure is coupled with words pointing out the instrument by which an inheritance is held: thus, if the holding be by copy of court roll. At other times this word is coupled with others, that show the principal service by which an inheritance is held; as where a man held by knight's service, it is called tenure by knight's service.

TERAMNUS, in botany, a genus of the Diadelphia Decandria class and order. Natural order of Papilionaceæ, or Leguminosæ. Essential character: keel very small concealed within the calyx; stamina alternate, five-barren; stigma sessile, headed. There are two species, *viz*. T. volubulis, and T. uncinatus, both natives of Jamaica.

TEREBELLA, in natural history, a genus of the Vermes Mollusca class and order. Body oblong, creeping, naked, often inclosed in a tube, furnished with lateral fascicles or tufts, and branchiæ, mouth placed before, furnished with lips, without teeth, and protruding a clavate proboscis; feelers numerous, ciliate, capillary, seated round the mouth. There are eleven species.

TEREDO, in natural history, *ship-worm*, a genus of the Vermes Testacea class

and order. Animal a terebella, with two calcareous hemispherical valves before, and two lanceolate ones behind; shell tapering, flexuous, and capable of penetrating wood. There are three species.

T. navalis, shell very thin, cylindrical, smooth; found in the sides and bottoms of ships, and the stoutest oak pales, which have remained some time under water, and was imported from India. The destruction which these worms effect under water, is almost equal to that of the Termes, or white ant, on land. (See TERMES.) The shell is more or less twisted, rather obtuse at the tip, and from four to six inches long. They will appear, on a very little consideration, to be most important beings in the great chain of creation, and pleasing demonstrations of the infinitely wise and gracious Power which formed, and still preserves, the whole in such wonderful order and beauty; for if it was not for the rapacity of these and such animals, tropical rivers, and indeed the ocean itself, would be choked with the bodies of tress which are annually carried down by the rapid torrents, as many of them would last for ages, and probably be productive of evils, of which, happily, we cannot in the present harmonious state of things form any idea; whereas now, being consumed by these animals, they are more easily broken in pieces by the waves; and the fragments which are not devoured become specifically lighter, and are consequently more readily and more effectually thrown on shore, where the sun, wind, insects, and various other instruments, speedily promote their entire dissolution. These animals are only found in salt water.

TERM, in geometry and algebra, is the extreme of any magnitude, or that which bounds and limits its extent. Thus the terms of a line, are points; of a superficies, lines; of a solid, superficies. The terms of an equation are the several names or members of which it is composed, separated from one another by the signs + or —. Thus the quantity $az + 2bc - 3az^2$ consists of three terms, az and $2bc$ and $3az^2$. In an equation, the terms are the parts which contain the several powers of the same unknown letter or quantity: for if the same unknown quantity be found in several members in the same degree or power, they pass for one term, which is called compound, in distinction from a simple or single term: thus in the equation $x^3 + \overline{a-3b}\,x^2 - acx = b^3$, the four terms are x^3 and $\overline{a-3b}.\,x^2$ and acx and b^3: of which the second term $\overline{a-3b}.\,x^2$ is compound, and the other three are simple terms. The terms of a product, or of a fraction, or of a ratio, or of a proportion, &c. are the several quantities employed in forming or composing them: thus the terms of the product ab are a and b: — of the fraction $\frac{7}{9}$ they are 7 and 9: — of the ratio 8 : 9 they are 8 and 9: and of the proportion $a:b::x:y$, the terms are a, b, x, and y.

TERM *in the arts*, or TERM *of art*, is a word which, besides the literal and popular meaning which it has, or may have, in common language, bears a further and peculiar meaning in some art or science.

TERM, in logic. A proposition is said to consist of two terms, *i. e.* two principal and essential words, the subject and the attribute.

TERMS, are those spaces of time in which the courts of justice are open for all that complain of wrongs or injuries, and seek their rights by course of law or action, in order to their redress, and during which the courts in Westminster-hall sit and give judgment, &c. But the high court of Parliament, the Chancery, and inferior courts, do not observe the terms; only the courts of King's Bench, Common Pleas, and Exchequer, the highest courts at common law. Of these terms, there are four in every year, *viz.* Hilary Term, which begins the 23d of January, and ends the 12th of February, unless on Sundays, and then the day after; Easter Term, which begins the Wednesday fortnight after Easter-day, and ends the Monday next after Ascension-day; Trinity Term, which begins the Friday after Trinity Sunday, and ends the Wednesday fortnight after; and Michaelmas Term, which begins the 6th, and ends the 28th of November.

There are, in each of these terms, stated days, called days in bank, that is, days of appearance in the Court of Common Pleas, called usually *bancum*, or *commune bancum*, to distinguish it from *bancum regis*, or the Court of King's Bench. They are generally at the distance of about a week from each other, and regulated by some festival of the church. On some of these days in bank, all original writs must be made returnable, and therefore they are generally called the returns of that term; the first return in every term is, properly speaking, the first day in that

term; and thereon the court sits to take essoins, or excuses, for such as do not appear according to the summons of the writ: wherefore this is usually called the essoin day of the term. But the person summoned hath three days grace beyond the return of the writ, in which to make his appearance; and if he appear on the fourth day inclusive, *quarto die post*, it is sufficient. Therefore, at the beginning of each term, the court doth not sit for dispatch of business till the fourth day; and in Trinity Term, by statute 32 Henry VIII. c. 21. not till the sixth day.

Terms, *Oxford.* Hilary, or Lent Term, begins on January 14, and ends the Saturday before Palm Sunday. Easter Term begins the tenth day after Easter, and ends the Thursday before Whit Sunday. Trinity Term begins the Wednesday after Trinity Sunday, and ends after the act, sooner or later, as the Vice Chancellor and Convocation please. Michaelmas Term begins on October 10, and ends December 7.

Terms, *Cambridge.* Lent Term begins on January 13, and ends the Friday before Palm Sunday. Easter Terms begins the Wednesday after Easter week, and ends the week before Whit Sunday. Trinity Term begins the Wednesday after Trinity Sunday, and ends the Friday after the commencement. Michaelmas Term begins October 10, and ends December 16.

Terms, *Scottish.* In Scotland, Candlemas Term begins January 23, and ends February 12. Whitsuntide Term begins May 25, and ends June 15. Lammas Term begins July 20, and ends August 8. Martinmas Term begins November 3, and ends November 29.

Terms, *Irish*, are the same as those in London, except that at Michaelmas, which commences October 13, and adjourns to the beginning of November.

TERMES, in natural history, a genus of insects of the order Aptera. Mouth with two horny jaws; lip horny, four-cleft, the divisions linear and acute; four-feelers, equal, filiform; two eyes. There are ten species, in two sections: A. antennæ moniliform; B. antennæ setaceous.

T. fatale, or white ant, is brown above; thorax with three segments; wings pale, with a testaceous rib. A most curious and wonderful account of this insect is given in the Philosophical Transactions, of which we shall notice a few particulars. The animal of this extraordinary community, far exceeding in wisdom and policy the bee, the ant, or beaver, are inhabitants of East India, Africa, and South America. They build pyramidal structures, ten or twelve feet in height, and divided into appropriate apartments, magazines for provisions, arched chambers, and galleries of communication. These are so firmly cemented, that they easily bear four men to stand upon them, and, in the plains of Senegal, appear like the villages of the natives. With such wonderful dexterity and rapidity they destroy food, furniture, books, clothes, and timber, of whatever magnitude, leaving a mere thin surface, that in a few hours a large beam will be eaten to a mere shell, not thicker than writing paper. Larva small, about a quarter of an inch long; six-footed, pale, with a roundish testaceous head; eyes none; mandibles short, strong, and toothed; antennæ as long as the thorax, and ovate abdomen. These only are the labourers, who build the structures, procure provisions for the males and females, and take care of the eggs: they are the most numerous. Pupa larger, about half an inch long, with a very large ovate polished testaceous head; eyes none; mandibles projecting as long as the head, forked, without teeth, sharp and black; thorax and abdomen palish.

These never work, but act as superintendants over the labourers, or as guards to defend their habitations from intrusion and violence. When a breach is made in the dwelling, they rush forward and defend the entrance with great ferocity; some of them beating with their mandibles against any hard substance, as a signal to the other guards, or as encouragement to the labourers; they then retire, and are succeeded by the labourers, each with a burthen of tempered mortar in his mouth, and who diligently set about to repair whatever injury has been sustained. One of these attends every six or eight hundred labourers who are building a wall, taking no active part himself, but frequently making the noise above mentioned, which is constantly answered by a loud hiss from all the labourers, who, at this signal, evidently redouble their diligence.

The male and female are alike, and furnished with four long horizontal wings; head small, brown; mandibles short, acute, toothed; antennæ yellowish; eyes globular, prominent, black; thorax with three brown or dull testaceous margined segments; abdomen ovate; the back brown, with white streaks; legs palish.

These are extricated from the pupa state, and fly abroad in the night; but

soon after sun-rise, the wings become dry, and they fall on the ground, and are devoured by birds, or sought after by the inhabitants, who roast and eat them with great avidity. A few that survive, are collected by the labourers, or larvæ, and inclosed by pairs in apartments made of clay, the aperture of which is narrowed so that they cannot migrate, and where they are diligently fed and attended by the labourers, whose bodies are small enough to admit an easy entrance.

After impregnation, the abdomen of the female grows to a prodigious bulk, exceeding the rest of her body nearly two thousand times; it is then vesicular and white, with transverse brown spots, and an undulate or slightly lobed margin. In this state it contains an immense number of small round brown eggs, which are protruded to the amount of eight thousand in twenty-four hours. These are instantly taken up by the labourers, and conveyed to separate chambers, where, after they are hatched, the young are attended and provided for till they are able to shift for themselves, and take their share in the labours of the community.

T. pulsatorius, is a very small insect, frequently found during the summer months in houses, particularly where the wainscot is in any degree decayed, and is remarkable for continuing a long continued sound, resembling the ticking of a watch. It is very common in collections of dried plants, which it injures very much. It is of so tender a frame as to be easily destroyed by the slighest pressure, and is an animal of very quick motions. When this insect is first hatched, it bears a complete resemblance to a common mite, but after awhile casts its skin, and undergoes a complete change.

TERMINALIA, in botany, a genus of the Polygamia Monoecia class and order. Natural order of Elæagni, Jussieu. Essential character: calyx five-parted; corolla none; stamens ten; hermaphrodite, style one; drupe inferior, boat-shaped. There are six species, natives of the East and West Indies.

TERNSTROEMIA, in botany, so named in memory of Ternstroem, known by his travels into China, a genus of the Polyandria Monogynia class and order. Natural order of Columniferæ. Aurantia, Jussieu. Essential character: calyx five-parted; corolla one-petalled, wheel-shaped, with the border bell-shaped, five or six-parted; anthers thick at the tip; berry juiceless, two-celled. There are five species.

TERELLA, an appellation given to a load-stone, when turned into a spherical figure, and is placed so, that its poles and equator, &c. correspond to the poles and equator of the world; as being a just representation of the great magnetical globe which we inhabit.

TERRIER, a book, or roll, wherein the several lands, either of a private person, or of a town, college, church, &c. are described. It should contain the number of acres, and the scite, boundaries, tenants' names, &c. of each piece or parcel.

TEST, in metallurgy, a vessel of the nature of the coppel, used for large quantities of metals at once. See ASSAYING.

TESTACEA, in natural history, an order of the class Vermes in the Linnean system. It is described as a Mollusca, that is, a soft animal, of a simple structure, covered with a calcareous habitation or shell. There are in this order thirty-six genera, in sections.

A. Multivalves: shells with many valves.

Chiton	Pholas
Lepas	

B. Bivalves: shell with two valves.

Anomia	Mytillus
Arca	Ostrea
Cardium	Pinna
Chama	Solen
Donax	Shondylus
Mactra	Tellina
Mya	Venus.

C. Univalves, with a regular spire.

Argonauta	Murex
Buccinum	Nautillus
Bulla	Nerita
Conus	Strombus
Cypræa	Trochus
Haliotis	Turbo
Helix	Voluta.

D. Univalves, without a regular spire.

Dentalium	Sabella
Patella	Teredo.
Serpula	

TESTES. See ANATOMY.

TESTUDO, the *tortoise*, in natural history, a genus of Amphibia of the order Reptiles. Generic character: body tailed, covered above and beneath, defended

by a bony covering, covered by a horny, scaly, or coriaceous integument; a bony mouth, without distinct teeth, and the upper mandible closing over the lower. These animals feed on sea-weeds or on worms, are extremely prolific; but in the state of eggs, and while very young, are the prey of various animals. Their movements are slow; they are capable of being tamed, and will in that state eat almost any thing presented to them. They exist long in such air as would be destructive to other animals of the same size, and have such tenaciousness of life, that it is stated they will exhibit convulsive movements for several days after their bodies have been opened, and even after their heads have been cut off. In cold latitudes, the land tortoise is torpid during the winter. There are thirty-five species, of which we shall notice the following.

T. Græca, or the European tortoise. The weight of this animal is three pounds, and the length of its shell about seven inches. It abounds in the countries surrounding the Mediterranean, and particularly in Greece, where the inhabitants not only eat its flesh and eggs, but frequently swallow its warm blood. In September or October it conceals itself, remaining torpid till February, when it re-appears. In June it lays its eggs, in holes exposed to the full beams of the sun, by which they are matured. The males will frequently engage in severe conflicts, and strike their heads against each other with great violence and very loud sounds. Tortoises attain most extraordinary longevity, and one was ascertained to have lived in the gardens of Lambeth, England, to the age of nearly 120 years. Its shell is preserved in the archiepiscopal palace. So reluctant is the vital principle to quit these animals, that Shaw informs us, from Redi, one of them lived for six months after all its brain was taken out, moving its limbs, and walking as before. Another lived twenty-three days after its head was cut off, and the head itself opened and closed its jaws for a quarter of an hour after its separation from the body. It may not only be tamed, but has in several instances exhibited proofs in that state of considerable sagacity, in distinguishing its benefactors, and of grateful attachment in return for their kindness, notwithstanding its general sluggishness and torpor. It will answer the purpose of a barometer, and uniformly indicates the fall of rain before night, when it takes its food with great rapidity, and walks with a sort of mincing and elate step. It appears to dislike rain with extreme aversion, and is discomfited and driven back only by a few and scarcely perceivable drops. See Amphibia, Plate II. fig. 4.

T. lutaria, or the mud tortoise, is common both in Europe and Asia, and particularly in France, where it is much used for food. It is seven inches long; lays its eggs on the ground, though an aquatic animal; walks quicker than the land tortoise; and is often kept in gardens, to clear them from snails and various wingless insects. In fish-ponds it is very destructive, biting the fishes; and when they are exhausted by the loss of blood, dragging them to the bottom and devouring them.

T. ferox, or the fierce tortoise, is found in several parts of North America, and is eighteen inches long. It is rapid and vigorous in its movement, and will spring on its enemy with great elasticity and violence. Its flesh is thought extremely good. It is found in the muddy parts of rivers, concealing itself among the weeds. It will also dart with great celerity on birds. But those of this genus most commonly used as food in the United States, are the T. concentrica, (Terrapin,) and the T. serpentaria, (Snapping Tortoise.)

The sea tortoises, or turtles, are distinguished from the former, by having very large and long feet, in the shape of fins, the claws of some of the toes not being visible, but inclosed.

T. mydas, or the common green turtle, is not unfrequently five feet long, and of the weight of 500 pounds; and is denominated green, from a shade of that colour assumed by the fat when the animal is in its perfect state. In the West Indies it has been long in the highest estimation for the table, and within sixty or seventy years it has gradually been advancing in reputation in this country for food, and is at present considered as furnishing the highest gratification of epicurism. It is imported into England in vast numbers. It feeds on sea grass called turtle grass. It is taken sometimes after being watched to its haunts; and being thrown on its back, is unable to rise again on its feet; sometimes it is struck in the water with a long staff, armed with iron at the end. The markets of the West Indies are supplied with the flesh of these animals as those of Europe are with mutton and beef; and before they were much sought as articles of exportation, forty sloops were employed by the inhabitants of Port Royal in catching them. They are seldom seen on land but at the season of laying

their eggs, which they do at several times, after intervals of fourteen days. They are occasionally found, probably in consequence of tempests, on the coasts of Europe.

T. imbricata, or the imbricated turtle, or hawksbill, is so called from its shells lapping one over another, like tiles on the roof of a house. It is about three feet long; is found in the seas both of Asia and America, and sometimes also in the Mediterranean; and is said to have been seen even of 600 pounds weight. Its flesh is in no estimation; but its lamina are manufactured into that elegant material, known by the name of tortoise-shell, which has been applied by human ingenuity to innumerable purposes both of use and ornament. The thickness of the plates varies in reference to the age and size of the turtle. Those of a very young one are of no value. A large one will supply ten pounds weight of valuable scales, which being softened by heat, and lapped over each other by means of pressure, become effectually united, so as to constitute one piece of considerable extent, and without any perceivable trace of their separation. This article was well known to the Greeks and Romans, and was an important material of luxury and commerce. Various articles of furniture, and even beds, were inlaid with it. The Egyptians exported large cargoes of it to Rome for these purposes; and in China, as well as Europe, it is at present in very high demand for elegant and ornamental manufactures.

TESTUDO, in the military art of the ancients, was a kind of cover or screen, which the soldiers, *e. gr.* a whole company, made themselves of their bucklers, by holding them up over their heads, and standing close to each other. This expedient served to shelter them from darts, stones, &c. thrown upon them, especially those thrown from above, when they went to the assault.

TESTUDO, was also a kind of large wooden tower which moved on several wheels, and was covered with bullock's hides flead, serving to shelter the soldiers when they approached the walls to mine them, or to batter them with rams.

TETHER, a string by which horses are held from ranging too far in pastures, &c. In figurative language, we say to go the length of one's tether; to speak or act with as much freedom as circumstances will admit.

TETHYS, in natural history, a genus of the Vermes mollusca class and order: body detached, rather oblong, fleshy, without peduncles; mouth with a terminal, cylindrical proboscis, under an expanded membrane or lip; two apertures on the left side of the neck. There are two species, *viz.* T. leporina, which inhabits the Mediterranean; and T. fimbria, found in the Adriatic.

TETRACERA, in botany, a genus of the Polyandria Tetragynia class and order. Natural order of Rosaceæ, Jussieu. Essential character; calyx five or six-leaved; corolla four or five-petalled; filaments widening above; and anther bearing on each side; capsules four, opening on the side; seed arilled at the base. There are twelve species.

TETRACHORD, in the ancient music, a concord consisting of four degrees or intervals, and four terms or sounds; called also by the ancients diatessarron, and by us a fourth.

TETRADYNAMIA, in botany, the name of the fifteenth class in the Linnæan system, consisting of plants with hermaphrodite flowers, having six stamina, four of which are longer than the rest. There are two orders in this class, *viz.* the siliquosæ, those that have long pods, as stocks, rockets, &c.; and the siliculosæ, or those that have short round pods, as scurvy-grass, candy-tuft, &c.

TETRAEDRON, or TETRAHEDRON, in geometry, one of the five regular or platonic bodies or solids, comprehended under four equilateral and equal triangles.

It is demonstrated by mathematicians, that the square of the side of a tetraedron is to the square of the diameter of a sphere, wherein it may be inscribed, in a subsequilateral ratio: whence it follows, that the side of a tetraedron is to the diameter of a sphere it is inscribed in, as $\sqrt{2}$ to the $\sqrt{3}$, consequently they are incommensurable.

TETRAGONIA, in botany, a genus of the Icosandria Pentagynia class and order. Natural order of Succulentæ. Ficoideæ, Jussieu. Essential character: calyx three to five-parted; petals none; drupe inferior, inclosing a nut from three to eight-celled. There are eight species, chiefly natives of the Cape of Good Hope.

TETRAGYNIA, in botany, the name of an order in certain classes of the Linnæan system, consisting of plants, which, to the classic character, add the circumstance of having four styles.

TETRANDRIA, in botany, the name of the fourth class in the Linnæan system, consisting of plants with hermaphrodite flowers, which have four stamina of equal length. In this last circumstance con-

sists the main difference between the tetrandria and the didynamia, in which the four stamina are of unequal length, two of them being longer than the other two. There are three orders in this class, founded upon the number of styles.

TETRANTHUS, in botany, a genus of the Syngenesia Polygamia Segregata class and order. Natural order of Capitatæ. Cinarocephalæ, Jussieu. Essential character: calyx common, four-flowered; perianth proper, one-leafed; seeds crowned. There is but one species, *viz.* T. littoralis, an annual plant, and a native of Hispaniola.

TETRAO, in natural history, a genus of birds of the order Gallinæ. Generic character: near each eye a spot, which is naked, or papillous, or slightly covered with feathers. Birds of this genus, which, according to Gmelin, comprehends the grouse, the partridge, and the quail, follow the dam immediately on being hatched, and before the shell is wholly detached from them; their bill is strong and convex, and their flesh and eggs form an exquisite repast. There are seventy-three species, of which the following are best deserving of notice.

T. urogallus, or the cock of the wood, is of the size of a turkey, and is found from Russia to Italy, preferring the elevated and mountainous parts of temperate countries, as it delights in a cold temperature. Its eggs are deposited on moss, and whenever left by the female, who is unassisted in the process of incubation, are covered over with leaves. The males and females live separate, except during the months of February and March. Their food consists of various plants and grains, and of buds of trees. The seeds of the pine and fir they are particularly fond of. The sound of the male resembles not a little the whetting of a scythe. These birds are in high request for the table, and are sometimes sent from Petersburg to London, in a very rigorous winter, arriving, it is said, in good condition.

T. tetrix, or the black grouse, is larger than a common fowl, and abounds in the British islands, particularly in the northern districts. In winter these birds shelter themselves in low situations. On the return of spring they withdraw to the mountains, and contests occur between the males, which are carried on with extreme violence and fury, and during which they are so agitated by rage, that they may be approached without observation, and knocked down with a club. The birds of this species, and of the last, do not pair like other birds, and the male is generally seen with several females in his train. They subsist on seeds and herbage, and are particularly fond of the seeds of the birch and Siberian poplar.

T. Canadensis, or the spotted grouse, is thirteen inches long, abounds in the neighbourhood of Hudson's Bay, and feeds upon juniper berries, and the cones of spruce. These birds are eaten by the natives, both in summer and winter, during the latter season being hung up by the bill, and preserved by the frost. They are extremely stupid, and will scarcely make an effort to evade danger.

T. lagopus, or the ptarmigan grouse, is fourteen inches long, and inhabits the north of Europe. It is not uncommon in the Orkneys and the Hebrides, and is sometimes found in Cumberland. These birds subsist on seeds, fruits, and berries, and are, like the last, silly and inadvertent to danger.

T. perdix, or the European partridge, is thirteen inches long, and abounds in the temperate regions of Europe. It is unable to sustain rigorous cold, or intense heat. It feeds on green corn and other plants, and almost every species of grain; but the eggs of ants constitute its favourite food, and are almost essential for the nourishment and preservation of the young ones. Experiments have been repeatedly, but ineffectually, made, to induce the breeding of this bird in confinement; its eggs, however, are frequently introduced into the nest of a common hen, and are thus matured, and the young are treated affectionately by that bird, and may be brought to perfection, if provided with their appropriate food. The attachment of the male and female partridge to their offspring, is highly interesting. They both sit covering them frequently at the same time, and, when danger approaches, will expose themselves to its direct attack, in order to decoy the attention of the enemy from those whose security they prefer even to their own existence. They pair early, build with dry leaves upon the ground, and the young run after their parent as soon as they are extricated from the shell. They breed in England only once a year, and live to the age of twelve years. They are highly valued for food.

T. coturnix, or the quail, is between seven and eight inches long, and inhabits almost every country of the old world, but is not found in America. It is migratory, and moves in spring towards the

colder climates, returning southerly in autumn. In these progresses quails fly in immense multitudes, and are taken in the islands of the Archipelago in such numbers as for a short time to be the principal article of food for the inhabitants, and to constitute an important source of income and revenue. Within a few miles along the coasts of Italy, a hundred thousand are said to have been taken in a single day. Latham informs us, that they used to be an article of importation from France to England, in cages formed with several divisions, and containing about a score of birds in each, and that he had often seen these cages filled with them, and attached to the stage coaches between Paris and London. They breed, however, in that country, and though many migrate beyond the island, many only change their residence within it, on the approach of winter, from the more exposed to the more sheltered parts. These birds were proverbial among the Romans for captiousness and quarrelling, and are employed among the Chinese for the same amusement as game cocks in England. They were so used, indeed, likewise among the ancients. It appears highly probable that the extraordinary supplies of the Israelites were derived from this species of birds in their vast flights to and from Africa; and though represented in Jewish history as a permanent supply, this circumstance may easily be accounted for, from the exaggerating and superlative phraseology which characterizes all oriental description.

TETRATOMA, in natural history, a genus of insects of the order Coleoptera. Antennæ clavate, the club perfoliate; lip rounded, entire; feelers thickish, unequal; shells as long as the abdomen. There are two species, *viz.* T. fungorum, found on tree-fungi, in Germany; and T. ancora.

TETRODON, in natural history, a genus of fishes of the order Cartilaginei. Generic character: jaws bony, divided at the end; body roughened beneath; no ventral fins; aperture of the gills linear. These fishes are chiefly met with in the seas between the tropics, and imagined to subsist principally on shell fish. They are distinguished by the faculty of inflating or compressing their bodies at pleasure, and continuing in either state for a considerable time. During inflation, the spines, which are scattered over the lower part of the body, are erected with great intensity. There are thirteen species. T. lagocephalus, or the hare tetrodon, is a foot long, very thick in front, but becoming perpetually more slender towards the tail. It is found in the American and Indian seas, has been very rarely taken on the British coast, and possesses the power of swelling itself to a size truly astonishing.

T. ocellatus, is seven inches long, and particularly abounds about Japan and China. It is taken for food, but requires to be cleaned with particular accuracy, as certain parts of it are reported to be highly poisonous. On this account it is prohibited to the military of Japan; but by a singular and capricious distinction, is still permitted to every other class of subjects.

For the tortoise-shell tetrodon, see Pisces, Plate VI. fig. 4.

TEUCRIUM, in botany, *germander*, so named from Teucer, son of Scamander, and father-in-law of Dardanus King of Troy, a genus of the Didynamia Gymnospermia class and order. Natural order of Verticillatæ. Labiatæ, Jussieu. Essential character: corolla, upper lip two-parted beyond the base, divaricating where the stamens are. There are sixty-nine species.

TEUTHIS, in natural history, a genus of fishes of the order Abdominales. Generic character: head truncated on the fore-part; gill membrane, with five rays; teeth equal, rigid, approximate, in a single row. There are two species. T. hepatus, has a recumbent moveable spine on each side the tail, and inhabits the seas of India and America.

T. Java, has an unarmed tail, lunated, and its body is marked with longitudinal black spots.

TEUTONIC *order*, a military order of knights, established towards the close of the twelfth century, and thus called, as consisting chiefly of Germans or Teutons. The origin, &c. of the Teutonic order is said to be this. The Christians, under Guy of Lusignan, laying siege to Acre, or Acon, a city of Syria, on the borders of the Holy Land, some Germans of Bremen and Lubeck, touched with compassion for the sick and wounded of the army, who wanted common necessaries, set on foot a kind of hospital under a tent, which they made of a ship's sail, and here betook themselves to a charitable attendance on them. This started a thought of establishing a third military order, in imitation of the Templars and Hospitallers. The design was approved of by the patriarch

of Jerusalem, the archbishops and bishops of the neighbouring places, the King of Jerusalem, the masters of the temple and hospital, and the German lords and prelates then in the Holy Land, and Pope Calixtus III. confirmed it by his bull, and the new order was called the order of Teutonic Knights of the house of St. Mary at Jerusalem. The Pope granted them all the privileges of the Templars and Hospitallers of St. John, excepting that they were to be subject to the patriarchs and other prelates, and that they should pay tythe of what they possessed.

TEXT, a relative term, contradistinguished to gloss or commentary, and signifying an original discourse, exclusive of any note or interpretation. This word is particularly used for a certain passage of scripture chosen by a preacher to be the subject of his sermon.

A text-book, in several universities, is a classic author written very wide by the students to give room for an interpretation dictated by the master or regent to be inserted in the interlines. The Spaniards give the name of text to a kind of little poem, or set of verses, placed at the head of a gloss and making the subject thereof, each verse being explained one after another in the course of the gloss.

THALES, in biography, a celebrated Greek philosopher, and the first of the wise men of Greece, born at Miletum about 640 years before the Christian æra. When he had acquired the usual learning of his country, he travelled into Asia and Egypt, to be instructed in geometry, astronomy, and natural philosophy. On his return he became a teacher of youth, and among his disciples, which were numerous, were Anaximander, Anaximenes, and Pythagoras. Thales was the author of the Ionian sect of philosophers; he was reckoned, by the best historians, the father of Greek philosophy, being the first that made any researches into natural knowledge and mathematics. He thought water was the principle of which all bodies in the universe are composed: that the world was the work of God, whom he regarded as omniscient, and beholding the secret thoughts in the heart of man. He maintained that real happiness consisted in health and knowledge: that the most ancient of beings is God, because he is uncreated; that nothing is more beautiful than the world, because it is the work of God; nothing more extensive than space, quicker than spirit, stronger than necessity, wiser than time. He used to observe, that we ought never to say that to any one which may be turned to our prejudice: and that we should live with our friends as with persons that may become our enemies. In geometry he was a considerable inventor, as well as an improver, particularly in triangles; and all the writers agree, that he was the first, even in Egypt, who took the height of the pyramids by the shadow. His knowledge and improvements in astronomy were very considerable. He divided the celestial sphere into five circles or zones; the arctic and antarctic circles, the two tropical circles, and the equator. He observed the apparent diameter of the sun, which he made equal to half a degree; and formed the constellation of the Little Bear. He observed the nature and course of eclipses, and calculated them exactly; one in particular, memorably recorded by Herodotus, as it happened on a day of battle between the Medes and Lydians, which Thales had foretold; and he divided the year into 365 days. He died at the age of ninety years, leaving behind him an excellent character, as a mathematician, a philosopher, and moralist.

THALIA, in botany, so named in memory of John Thalius, a physician at Nordhuys, a genus of the Monandria Monogynia class and order. Natural order of Scitamineæ. Cannæ, Jussieu. Essential character; calyx three leaved; corolla five-petalled, two inner petals less; nectary lanceolate, concave; drupe with a one-celled nut. There are two species, *viz.* T. geniculata, and T. cannæformis; the former is a native of South America, the latter of Mallicollo, one of the New Hebrides, in Australasia; it was also found in the Andaman Isles, and Rangoon, in the kingdom of Pegue, by Dr. Buchanan.

THALICTRUM, in botany, *meadow rue*, a genus of the Polyandria Polygynia class and order. Natural order of Multisilique. Ranunculaceæ, Jussieu. Essential character: calyx none; petals four or five; seeds tailless. There are twenty-two species.

THALLITE, in mineralogy, a stone found in the fissures of mountains in Dauphiny, and on Chamouni, in the Alps. It is sometimes amorphous, and sometime chrystallized. It is brittle. Specific gravity about 3.4. Before the blow-pipe it froths, and melts into a black flag; with borax it melts into a green bead. The constitutent parts are,

Silica	37.0
Alumina	27.0
Oxide of iron	17.0
Lime	14.0
Oxide of manganese	1.5
	96.5
Loss	3.5
	100.0

THAPSIA, in botany, a genus of the Pentandria Digynia class and order. Natural order of Umbellatæ, or Umbelliferæ. Essential character: fruit oblong, surrounded by a membrane. There are six species.

THEA, in botany, *tea-tree*, a genus of the Polyandria Monogynia class and order. Natural order of Columniferæ. Aurantia, Jussieu. Essential character: corolla six or nine petalled; calyx five or six leaved: capsule tricoccous.

The tea plant is a native of Japan, China, and Tonquin, and has not been found growing spontaneously in any other part of the world.

Linnæus says that there are two species of the tea plant; the bohea, the corolla of which has six petals; and the viridis, or green tea, which has nine petals. Thunberg makes only one species, the bohea, consisting of two varieties; the one with broad, and the other with narrow leaves. This botanist's authority is decisive respecting the Japanese tea plants; but as China has not yet been explored, we cannot determine what number of species there are in that country. The tea-tree, however, is now common in the botanical gardens in this country; and it is evident that there are two species, or, at least, permanent varieties of it; one with a much longer leaf than the other, which our gardeners call the green tea; and the other with shorter leaves, which they call the bohea. The green is by much the hardiest plant, and with very little protection will bear the rigour of our winters.

This plant delights in valleys, and is frequent on the sloping sides of mountains and the banks of rivers, where it enjoys a southern exposure. It flourishes in the northern latitudes of Pekin as well as round Canton; but attains the greatest perfection in the mild temperate regions of Nankin. It is said only to be found between the 30th and 45th degree of north latitude. In Japan it is planted round the borders of fields, without regard to the soil; but as it is an important article of commerce with the Chinese, whose fields are covered with it, it is by them cultivated with care. The Abbé Rochon says it grows equally well in a poor as in a rich soil; but that there are certain places where it is of a better quality. The tea which grows in rocky ground is superior to that which grows in a light soil; and the worst kind is that which is produced in a clay soil. It is propagated by seeds; from six to twelve are put into a hole about five inches deep, at certain distances from each other. The reason why so many seeds are sown in the same hole is said to be, that only a fifth part vegetate. Being thus sown, they grow without any other care. Some, however, manure the land, and remove the weeds; for the Chinese are as fond of good tea, and take as much pains to procure it of an excellent quality, as the Europeans do to procure excellent wine.

The leaves are not fit for being plucked till the shrub is of three years' growth. In seven years it rises to a man's height; but as it then bears but few leaves, it is cut down to the stem, and this produces a new crop of fresh shoots the following summer, every one of which bears nearly as many leaves as a whole shrub. Sometimes the plants are not cut down till they are ten years old. We are informed, by Kæmpfer, that there are three seasons in which the leaves are collected in the isles of Japan, from which the tea derives different degrees of perfection.

The first gathering commences at the end of February or beginning of March. The leaves are then small, tender, and unfolded, and not above three or four days old: it is called imperial tea, being generally reserved for the court and people of rank; and sometimes also it is named bloom tea. It is sold in China for 20*d.* or 2*s.* per pound. The labourers employed in collecting it do not pull the leaves by handfuls, but pick them up one by one, and take every precaution that they may not break them. However long and tedious this labour may appear, they gather from four to ten or fifteen pounds a day.

The second crop is gathered about the end of March or beginning of April. At this season part of their leaves have attained their full growth, and the rest are not above half their size. This difference does not, however, prevent them from being all gathered indiscriminately. They are afterwards picked and assorted

into different parcels, according to their age and size. The youngest, which are carefully separated from the rest, are often sold for leaves of the first crops, or for imperial tea. Tea gathered at this season is called Chinese tea, because the people of Japan infuse it, and drink it after the Chinese manner.

The third crop is gathered in the end of May, or in the month of June. The leaves are then very numerous and thick, and have acquired their full growth. This kind of tea is the coarsest of all, and is reserved for the common people. Some of the Japanese collect their tea only at two seasons of the year, which correspond to the second and third already mentioned: others confine themselves to one general gathering of their crop, towards the month of June: however, they always form afterwards different assortments of their leaves.

In this country, teas are generally divided into three kinds of green, and five of bohea: the former are, 1. Imperial, or bloom tea, with a large loose leaf, light green colour, and a faint delicate smell. 2. Hyson, so called from the name of the merchant who first imported it; the leaves of which are closely curled and small, of a green colour, verging to a blue. 3. Singlo tea, from the name of the place where it is cultivated. The boheas are, 1. Souchong, which imparts a yellow-green colour by infusion. 2. Camho, so called from the place where it is made; a fragrant tea, with a violet smell; its infusion pale. 3. Congo, which has a larger leaf than the preceding, and its infusion somewhat deeper, resembling common bohea in the colour of the leaf. 4. Pekoe tea; this is known by the appearance of small white flowers mixed with it. 5. Common bohea, whose leaves are of one colour. There are other varieties, particularly a kind of green tea, done up in roundish balls, called gunpowder tea.

THELYGONUM, in botany, a genus of the Monoecia Polyandria class and order. Natural order of Scabridæ. Urticæ, Jussieu. Essential character: male, calyx bifid; corolla none; stamina commonly twelve: female, calyx bifid; corolla none; pistil one; capsule coriaceous, one-celled, one-seeded. There is only one species, *viz.* T. cynocrambe, purslain-leaved thelygonum, or dog's cabbage: this is an annual plant, decaying as soon as the seeds ripen; the stalks trail on the ground like those of chick-weed; they grow about a foot in length, having acute pointed leaves, on long bordered foot-stalks; flowers axillary, in clusters, sitting very close, small, and of an herbaceous white colour; male and female from the same joint; it is a native of the South of France, near Montpelier.

THEOBROMA, in botany, a genus of the Polyadelphia Decandria class and order. Natural order of Columniferæ. Malvaceæ, Jussieu. Essential character: calyx five-leaved; petals five, arched; nectary five-horned; filaments five, within the calyx of the petals, growing externally to the nectary, having two anthers on each. There is but one species, *viz.* T. cacao, chocolate nut tree, which grows in a very handsome form, to the height of twelve or sixteen feet; the wood is light, and of a white colour; the bark is brownish and even; leaves lanceolate, oblong, bright green, entire, from nine to sixteen inches long, and from three to four in the widest part, on a petiole an inch in length, thickened at both ends; peduncles slender, eight or ten together, chiefly from the scars of fallen leaves; flowers small, reddish, inodorous; fruit smooth, yellow and red, about three inches in diameter; rind fleshy, half an inch in thickness; pulp whitish, the consistence of butter, separating from the rind in a state of ripeness, and adhering to it only by filaments, which penetrate it and reach to the seeds; when the seeds are ripe, it is known by the rattling of the capsule when shaken. This tree bears leaves, flowers, and fruit, all the year through; the usual seasons for gathering the fruit are June and December; one tree yields from two to three pounds of seeds annually. It is a native of South America; it is also found in several places between the Tropics, particularly at Caracca and Carthagena, on the river Amazons, the Isthmus of Darien, &c. This tree is cultivated in many of the West India islands, belonging to the French and Spaniards, and formerly in some of those belonging to the English, but has been neglected in the latter for many years past.

THEODOLITE, a mathematical instrument much used in surveying, for the taking of angles, distances, &c. It is made variously, several persons having their several ways of contriving it, each more simple and portable, more accurate and expeditious than others. The common one consists of a brass circle about a foot diameter, having its limb divided into 360 degrees, and each degree subdivided, either diagonally, or otherwise, into minutes. See Level.

THEODOSIUS, in biography, a cele-

brated mathematician, who flourished in the times of Cicero and Pompey; but the time and place of his death are unknown. He chiefly cultivated that part of geometry which relates to the doctrine of the sphere, concerning which he published three books. The first of these contains twenty-two propositions; the second twenty-three; and the third fourteen; all demonstrated in the pure geometrical manner of the ancients. Ptolemy made great use of these propositions, as well as all succeeding writers. These books were translated by the Arabians, out of the original Greek, into their own language. From the Arabic, the work was again translated into Latin, and printed at Venice. But the Arabic version being very defective, a more complete edition was published in Greek and Latin, at Paris, 1558. And Vitello acquired reputation by translating Theodosius into Latin. This author's works were also commented on and illustrated by Clavius, and others; but the edition of Theodosius's Spherics which is now most in use, was translated, and published, by our countryman, the learned Dr. Barrow, in the year 1675, illustrated and demonstrated in a new and concise method. By this author's account, Theodosius appears not only to be a great master in this more difficult part of geometry, but the first considerable author of antiquity who has written on that subject.

THEOPHRASTA, in botany, so named in honour of the celebrated Grecian philosopher and botanist, Theophrastus Eresius, a genus of the Pentandria Monogynia class and order. Natural order of Apocineæ, Jussieu. Essential character: corolla bell-shaped, with oblong erect spreading segments; fruit one-celled, very large, roundish, many-seeded. There are two species, *viz.* T. americana and T. longifolia, both natives of America.

THEOREM, a speculative proposition, demonstrating the properties of any subject. Theorems are either universal, which extend to any quantity, without restriction, universally; as this, that the rectangle of the sum, and difference of any two quantities, is equal to the difference of their squares; or particular, which extend only to a particular quantity; as this, in an equilateral right-lined triangle, each of the angles is 60 degrees. Theorems are again distinguished into negative, local, plane, and solid. A negative theorem is that which expresses the impossibility of any assertion; as, that the sum of two biquadrate numbers cannot make a square number. A local theorem is that which relates to a surface; as, that the triangles of the same base and altitude are equal. A plane theorem is that which either relates to a rectilinear surface, or to one terminated by the circumference of a circle; as, that all angles in the same segment of a circle are equal. And a solid theorem is that which considers a space terminated by a solid line; that is, by any of the three conic sections, *e. gr.* this; that if a right line cut two asymptotic parabolas, its two parts terminated by them shall be equal.

THEORY, in general, denotes any doctrine which terminates in speculation alone, without considering the practical uses and application thereof.

THERMOMETER, an instrument for measuring the degree of heat or cold in any body. The first form of this instrument for measuring the degrees of heat and cold, was the air thermometer. It is a well known fact that air expands with heat so as to occupy more space than it does when cold, and that it is condensed by cold so as to occupy less space than when warmed, and that this expansion and condensation is greater or less according to the degree of heat or cold applied. The principle then on which the air-thermometer was constructed is very simple. The air was confined in a tube by means of some coloured liquor; the liqour rose or fell according as the air became expanded or condensed. What the first form of the tube was, cannot now perhaps be well known; but the following description of the air-thermometer will fully explain its nature. It consists of a glass tube, B E, (Plate Miscel. XVI. fig. 4.) connected at one end with a large glass ball, A, and at the other end immersed in an open vessel, or terminating in a ball, D E, with a narrow orifice at D; which vessel or ball contains any coloured liquor that will not easily freeze. Aquafortis tinged of a fine blue colour with a solution of vitriol or copper, or spirit of wine tinged with cochineal, will answer this purpose. But the ball, A, must be first moderately warmed, so that a part of the air contained in it may be expelled through the orifice, D; and then the liquor pressed by the weight of the atmosphere will enter the ball, D E, and rise, for example, to the middle of the tube, at C at a mean temperature of the weather; and in this state the liquor by its weight, and the air included in the ball, A, &c. by its elasticity, will counterbalance the weight of the atmosphere. As

the surrounding air becomes warmer, the air in the ball and upper part of the tube, expanding by heat, will drive the liquor into the lower ball, and consequently its surface will descend; on the contrary, as the ambient air becomes colder, that in the ball is condensed, and the liquor, pressed by the weight of the atmosphere, will ascend; so that the liquor in the tube will ascend or descend more or less according to the state of the air contiguous to the instrument. To the tube is affixed a scale of the same length, divided upwards and downwards from the middle, C, into 100 equal parts, by means of which the ascent and descent of the liquor in the tube, and consequently the variations in the cold or heat of the atmosphere, may be observed.

The air being found improper for measuring with accuracy the variations of heat and cold, according to the form of the thermometer which was first adopted, another fluid was proposed about the middle of the seventeenth century by the Florentine Academy. This fluid was spirt of wine, or alcohol, as it is now generally named. The alcohol being coloured, was inclosed in a very fine cylindrical glass tube previously exhausted of its air, having a hollow ball at one end, A, (fig. 5.) and hermetically sealed at the other end, D. The ball and tube are filled with rectified spirit of wine to a convenient height, as to C, when the weather is of a mean temperature, which may be done by inverting the tube into a vessel of stagnant coloured spirit, under a receiver of the air-pump, or in any other way. When the thermometer is properly filled, the end D is heated red hot by a lamp, and then hermetically sealed, leaving the included air of about one-third of its natural density, to prevent the air which is in the spirit from dividing it in its expansion. To the tube is applied a scale, divided from the middle, into 100 equal parts, upwards and downwards. As spirit of wine is capable of a very considerable degree of rarefaction and condensation by heat and cold, when the heat of the atmosphere increases the spirit dilates, and consequently rises in the tube; and when the heat decreases, the spirit descends, and the degree or quantity of the motion is shown by a scale.

This was evidently an improvement on the air-thermometer, but was itself not free from objections. The liquor could not easily be obtained of the same strength, and hence different tubes filled with it, when exposed to the same degree of heat, would not correspond. Another defect was, the want of some fixed guide as a standard to commence the graduation. Philosophers soon saw that some fixed and unalterable point must be found, by which all thermometers might be accurately adjutsed. Dr. Halley proposed that thermometers should be graduated in a deep pit, where the temperature in all seasons was nearly the same. This however could not generally be practised. He thought of the boiling point of water, of mercury, and of spirit of wine, preferring the latter, on account of the freezing of water, not knowing that this was fixed and uniform. At length Sir Isaac Newton determined this important point, on which the accuracy and value of the thermometer depends. He chose, as fixed, those points at which water freezes and boils; the very points which the experiments of succeeding philosophers have determined to be the most fixed and convenient. Sensible of the disadvantages of spirit of wine, he tried another liquor which was homogeneous enough, and capable of a considerable rarefaction, several times greater than spirit of wine. This was linseed oil. It has not been observed to freeze even in very great colds, and it bears a heat very much greater than water before it boils. With these advantages it was made use of by Sir Isaac Newton, who discovered by it the comparative degree of heat for boiling water, melting wax, boiling spirit of wine, and melting tin; beyond which it does not appear that this thermometer was applied. The method he used for adjusting the scale of this oil-thermometer was as follows: supposing the bulb, when immerged in thawing-snow, to contain 10,000 parts, he found the oil expand by the heat of the human body, so as to take up one thirty-ninth more space, or 10,256 such parts; and by the heat of water boiling strongly 10,725; and by the heat of melting tin 11,516. So that reckoning the freezing point as a common limit between heat and cold, he began his scale there, marking it 0, and the heat of the human body he made 12°; and consequently, the degress of heat being proportional to the degrees of rarefaction, or 256 : 725 :: 12 : 34, this number 34 will express the heat of boiling water; and by the same rule, 72 that of melting tin. This thermometer was constructed in 1701. To the application of oil as a measure of heat and cold, there are insuperable objections. It is so viscid, that it adheres too strongly to the

sides of the tube. On this account it ascends and descends too slowly in case of a sudden heat or cold. In a sudden cold, so great a portion remains adhering to the sides of the tube after the rest has subsided, that the surface appears lower than the corresponding temperature of the air requires. An oil thermometer is therefore not a proper measure of heat and cold. All the thermometers hitherto proposed were liable to many inconveniences, and could not be considered as exact standards for pointing out the various degrees of temperature. This led Reaumur to attempt a new one, an account of which was published in the year 1730 in the Memoirs of the Academy of Sciences. This thermometer was made with spirit of wine. He took a large ball and tube, the dimensions and capacities of which were known; he then graduated the tube, so that the space from one division to another might contain 1,000th part of the liquor; the liquor containing 1,000 parts when it stood at the freezing point. He adjusted the thermometer to the freezing point by an artificial congelation of water; then putting the ball of his thermometer and part of the tube into boiling water, he observed whether it rose 80 divisions; if it exceeded these, he changed his liquor, and by adding water lowered it, till upon trial it should just rise 80 divisions; or if the liqour, being too low, fell short of eighty divisions, he raised it by adding rectified spirit to it. The liquor thus prepared suited his purpose, and served for making a thermometer of any size, whose scale would agree with his standard. At length a different fluid was proposed, by which thermometers could be made free from most of the defects hitherto mentioned. This fluid was mercury, and seems first to have occurred to Dr. Halley, but was not adopted by him, on account of its having a smaller degree of expansibility than the other fluids used at that time.

The honour of this invention is generally given to Fahrenheit of Amsterdam, who presented an account of it to the Royal Society of London in 1724. That we may judge the more accurately of the propriety of employing mercury, we will compare its qualities with those of the fluids already mentioned, air, alcohol, and oil. Air is the most expansible fluid, but it does not receive nor part with its heat so quickly as mercury. Alcohol does not expand much by heat. In its ordinary state it does not bear a much greater heat than 175° of Fahrenheit; but when highly rectified, it can bear a greater degree of cold than any other liquor hitherto employed as a measure of temperature. At Hudson's Bay, Mr Macnab, by a mixture of vitriolic acid and snow, made it to descend to 69° below 0 of Fahrenheit. There is an inconvenience, however, attending the use of this liquor; it is not possible to get it always of the same degree of strength. As to oil, its expansion is about 15 times greater than that of alcohol; it sustains a heat of 600°, and its freezing point is so low that it has not been determined; but its viscosity renders it useless.

Mercury is far superior to alcohol and oil, and is much more manageable than air. 1. As far as the experiments already made can determine, it is, of all the fluids hitherto employed in the construction of thermometers, that which measures most exactly equal differences of heat by equal differences of its bulk: its dilatations are, in fact, very nearly proportional to the augmentations of heat applied to it. 2. Of all liquids it is the most easily freed from air. 3. It is fitted to measure high degrees of heat and cold. It sustains a heat of 600° of Fahrenheit's scale, and does not congeal till it fall 39 or 40 degrees below 0. 4. It is the most sensible of any fluid to heat and cold, even air not excepted. Count Rumford found, that mercury was heated from the freezing to the boiling point in 58 seconds, while water took 2 minutes 13 seconds, and common air 10 minutes and 17 seconds. 5. Mercury is a homogeneous fluid, and every portion of it is equally dilated or contracted by equal variations of heat. Any one thermometer, made of pure mercury, is, *cæteris paribus*, possessed of the same properties with every other thermometer made of pure mercury. Its power of expansion is indeed about six times less than that of spirit of wine, but it is great enough to answer most of the purposes for which a thermometer is wanted. The fixed points, which are now universally chosen for adjusting thermometers to a scale, and to one another, are the boiling and freezing water points. The boiling water point, it is well known, is not an invariable point, but varies some degrees, according to the weight and temperature of the atmosphere. In an exhausted receiver, water will boil with a heat of 98° or 100°; whereas, in Papin's digester, it will acquire a heat of 412°. Hence it appears, that water will boil at a lower point, according to its height in the atmosphere,

or to the weight of the column of air which presses upon it. In order to ensure uniformity, therefore, in the construction of thermometers, it is now agreed, that the bulb of the tube be plunged in the water when it boils violently, the barometer standing at 30 English inches, and the temperature of the atmosphere 55°. A thermometer made in this way, with its boiling point at 212°, is called, by Dr. Horsley, "Bird's Fahrenheit," because Mr. Bird was the first person who attended to the state of the barometer in constructing thermometers.

As artists may be often obliged to adjust thermometers under very different pressures of the atmosphere, philosophers have been at pains to discover a general rule, which might be applied on all occasions. M. de Luc, from a series of experiments, has given an equation for the allowance on account of this difference, in Paris measure, which has been verified by Sir George Schuckburg; also Dr. Horsley, Dr. Maskelyne, and Sir George Schuckburg, have adapted the equation and rules to English measures, and have reduced the allowances into tables, for the use of the artist. Dr. Horsley's rule, deduced from De Luc's, is this:

$$\frac{99}{8990000} \log. z - 92.804 = h.$$

Where h denotes the height of a thermometer plunged in boiling water above the point of melting ice, in degrees of Bird's Fahrenheit, and z the height of the barometer in 10ths of an inch. From this rule he has computed the following table, for finding the heights to which a good Bird's Fahrenheit will rise, when plunged in boiling water, in all states of the barometer, from 27 to 31 English inches; which will serve, among other uses, to direct instrument-makers in making a true allowance for the effect of the variation of the barometer, if they should be obliged to finish a thermometer at a time when the barometer is above or below 30 inches; though it is best to fix the boiling point when the barometer is at that height.

EQUATION OF THE BOILING POINT.

Barometer.	Equation.	Difference.
31.0	+ 1.57	0.78
30.5	+ 0.79	0.79
30.0	0.00	0.80
29.5	— 0.80	0.82
29.0	— 1.62	0.83
28.5	— 2.45	0.85
28.0	— 3.31	0.86
27.5	— 4.16	0.88
27.0	— 5.04	

The numbers in the first column of this table express heights of the quicksilver in the barometer, in English inches and decimal parts: the second column shows the equation to be applied, according to the sign prefixed, to 212° of Bird's Fahrenheit, to find the true boiling point for every such state of the barometer. The boiling point, for all intermediate states of the barometer, may be had, with sufficient accuracy, by taking proportional parts, by means of the third column of differences of the equations.

The method of constructing Fahrenheit's thermometer, which is now in general use in this country, is the following: a small ball is blown on the end of a glass tube, of an uniform width throughout. The ball and part of the tube are then to be filled with quicksilver, which has been previously boiled to expel the air. The open end of the tube is then to be hermetically sealed. The next object is to construct the scale. It is found, by experiment, that melting snow, or freezing water, is always at the same temperature. If, therefore, a thermometer be immersed in the one or the other, the quicksilver will always stand at the same point. It has been observed, too, that water boils under the same pressure of the atmosphere at the same temperature. A thermometer, therefore, immersed in boiling water, will uniformly stand at the same point. Here, then, are two fixed points, from which a scale may be constructed, by dividing the intermediate space into equal parts, and carrying the same divisions as far above and below the two fixed points as may be wanted. Thus, thermometers constructed in this way may be compared together; for if they are accurately made, and placed in the same temperature, they will always point to the same degree on the scale. The fluid, as we have seen, employed is quicksilver, and it is found to answer best, because its expansions are most equable. The freezing point of Fahrenheit's thermometer is marked 32°; and the reason of this is said to have been, that this artist thought that he had produced the greatest degree of cold, by a mixture of snow and salt; and the point at which the thermometer then stood, in this temperature, was marked Zero. The boiling point, in this thermometer, is 212°, and the intermediate space, between the boiling and freezing points, is therefore divided into 180°. This is the thermometer that is commonly used in Britain.

There are three other thermometers employed in different countries of Eu-

rope, which differ from each other in the number of degrees between the freezing and boiling points. Reaumur's thermometer was generally used in France before the revolution, and is still employed in different countries on the Continent. The freezing point, in this thermometer, is marked Zero, and the boiling point 80°. To convert the degrees of Reaumur's thermometer to those of Fahrenheit, the following is the formula. Reaum. $\frac{\times 9}{4} + 32 =$ Fahr. that is, multiply the degrees of Reaumur by 9, divide by 4, and add 32. This gives the corresponding degrees on Fahrenheit's scale. The thermometer of Celsus has the space between the freezing and boiling points divided into 100°. The boiling point is 100°, and the freezing point Zero. This thermometer is used in Sweden. The "thermometre centigrade," now used in France, has the scale divided in the same way. To convert the degrees of this thermometer into those of Fahrenheit; Cel. $\frac{\times 9}{5} + 32 =$ Fahr. In Delisle's thermometer, which is used in Russia, the space between the boiling and freezing points is divided into 150°; but the degrees are reckoned downwards. The boiling point is marked Zero, and the freezing point 150°. To reduce the degrees of this thermometer under the boiling point to those of Fahrenheit; Del. $\frac{\times 6}{5} - 212 =$ Fahr. And above the boiling point. Del. $\frac{\times 6}{5} + 212 =$ Fahr.

Such, then, are the principles and mode of construction of the thermometer; an instrument which has been of the utmost importance in enabling us to discover many of the properties and effects of caloric, as by it only we can ascertain, with accuracy, the relative temperatures.

In meteorological observations, it is necessary to attend to the greatest rise and fall of the thermometer; and therefore attempts have been made to make them mark the greatest degree of heat and cold, in the absence of the observer. We will notice one, intended to show the greatest degree of heat. AB, fig. 6, is a glass tube, with a cylindrical bulb, B, at the lower end, and capillary at the other, over which there is a fixed glass ball, C. The bulb, and part of the tube, are filled with mercury, the top of which shows the degrees of heat. The upper part of the tube, above the mercury, is filled with spirit of wine; the ball, C, is likewise filled with the same liquor, almost to the top of the capillary tube. When the mercury rises, the spirit of wine is also raised into the ball, C, which is so made that the liquor cannot return into the tube when the mercury sinks; of course, the height of the spirit in the ball, added to that in the tube, will give the greatest degree of heat. To make a new observation, the instrument must be inclined till the liquor in the ball cover the end of the capillary tube.

In 1782, Mr. Six proposed another self-registering thermometer. It is properly a spirit of wine thermometer, though mercury is also employed for supporting an index: *a b* (fig. 7) is a thin tube of glass sixteen inches long, and five-sixteenths of an inch calibre: *c d e*, and *f g h*, are smaller tubes, about one-twentieth of an inch calibre. These three tubes are filled with highly rectified spirit of wine, except the space between *d* and *g*, which is filled with mercury. As the spirit of wine contracts or expands in the middle tube, the mercury falls or rises in the outside tubes. An index, such as that represented in fig. 8, is placed on the surface, within each of these tubes, so light as to float upon it: *k* is a small glass tube, three-fourths of an inch long, hermetically sealed at each end, and inclosing a piece of steel wire nearly of its own length. At each end, *l m*, of this small tube, a short tube of black glass is fixed, of such a diameter as to pass freely up and down within either of the outside tubes of the thermometer, *c e* or *f h*. From the upper end of the index is drawn a spring of glass to the fineness of a hair, and about five-sevenths of an inch long; which being placed a little oblique, presses lightly against the inner surface of the tube, and prevents the index from descending when the mercury descends. These indexes being inserted one into each of the outside tubes, it is easy to understand how they point out the greatest heat or cold that has happened in the observer's absence. When the spirit of wine in the middle tube expands, it presses down the mercury in the tube, *h f*, and consequently raises it in the tube, *e o*; consequently, the index on the left hand tube is left behind, and marks the greatest cold, and the index in the right hand tube rises, and marks the greatest heat.

The common contrivance for a self-registering thermometer, now sold in most of the London shops, consists simply of

two thermometers, one mercurial, and the other of alcohol, (fig. 9) having their stems horizontal; the former has for its index a small bit of magnetical steel wire; and the latter a minute thread of glass, having its two ends formed into small knobs, by fusion in the flame of a candle.

The magnetical bit of wire lies in the vacant space of the mercurial thermometer, and is pushed forward by the mercury whenever the temperature rises, and pushes that fluid against it; but when the temperature falls, and the fluid retires, this index is left behind, and consequently shows the maximum. The other index, or bit of glass, lies in the tube of the spirit thermometer immersed in the alcohol: and when the spirit retires, by depression of temperature, the index is carried along with it, in apparent contact with its interior surface; but, on increase of temperature, the spirit goes forward and leaves the index, which therefore shows the minimum of temperature since it was set. As these indexes merely lie in the tubes, their resistance to motion is altogether inconsiderable. The steel index is brought to the mercury by applying a magnet on the outside of the tube, and the other is duly placed at the end of the column of alcohol, by inclining the whole instrument.

THERMOSCOPE, an instrument showing the changes happening in the air with respect to heat and cold. The word thermoscope is generally used indifferently with that of thermometer, though there is some difference in the literal import of the two; the first signifying an instrument that shows, or exhibits, the changes of heat, &c. to the eye; and the latter, an instrument that measures those changes; on which foundation the thermometer should be a more accurate thermoscope, &c.

THESIS, a general position which a person advances, and offers to maintain. In colleges it is frequent to have placards, containing a number of them, in theology, in medicine, in philosophy, in law, &c.

THESIUM, in botany, a genus of the Pentandria Monogynia class and order. Natural order of Vepreculæ. Elæagni, Jussieu. Essential character: calyx one-leaved, into which the stamens are inserted; nut inferior, one seeded. There are nineteen species, almost all of which are found at the Cape of Good Hope.

THIMBLE, an instrument made of brass, silver, iron, &c. put on the finger to thrust a needle through any cloth, silk, &c. used by all seamstresses, tailors, &c. The common thimbles are generally made of shruff and old hammered brass. This they melt and cast into a sort of sand, with which and red ochre are made moulds and cores. They are cast in double rows, and, when cold, taken out, and cut off with greasy shears. Then the cores being taken out, they are put into a barrel, as they do shot, and turned round with a horse till they rub the sand one from another: from thence they are carried to the mill to be turned, first on the inside, and afterwards on the outside: then some saw-dust, or filings of horn combs, are put half-way into each thimble, and upon it an iron punch; and then with one blow against a studded steed the hollow of the bottom is made: after this, with an engine, the sides have the hollow made; this done, they are again polished on the inside; then the rim is turned at one stroke; and lastly, they are turned in a barrel with saw-dust, or bran, to scour them very bright.

Thimble, in naval affairs, a sort of iron ring, the outer surface of which is hollow throughout its whole circumference, in order to contain in the channel or cavity a rope, which is spliced about it, and by which it may be hung in any particular situation. Its use is to defend the eye of the rope which surrounds it from being injured by another rope which passes through it, or by the hook of a tackle which is hung upon it.

THIRPS, in natural history, a genus of insect of the order of Hemiptera: snout obsolete, secreted within the mouth; antennæ filiform, as long as the thorax; body linear; abdomen bent upwards; four wings straight, incumbent, narrower than the body, and slightly crossed. There are eight species. T. physapus is accurately described in the Linnæan Transactions: it is found frequently in composite flowers, and in the spikes of wheat and rye, to which it is said to be exceedingly destructive, though others deny the fact. It may be often seen in the flowers of the dandelion; it wanders from petal to petal, descending to the bottom of the florets, occasionally emerging at intervals, and often skipping from place to place; in performing this action, it is observed suddenly to turn back its abdomen, so as nearly to touch the thorax with its tip. The larva, in some respects, resembles the complete insect: it is, however, yellow, and six-

footed: the antennæ and head black and white, pupa whitish, with black eyes.

THISTLE, *carduus*, in botany. See CARDUUS.

THISTLE, *order of the*, or *of St.* ANDREW, a military order of knighthood in Scotland, the rise and institution whereof is variously related by different authors: Lesley, Bishop of Ross, reports, that the night before the battle between Athelstan, King of Northumberland, and Hungus, King of the Picts, a bright cross, in form of that whereon St. Andrew (the tutelar saint of Scotland) suffered martyrdom, appeared to Hungus, who, having gained the victory, ever after bore the figure of that cross on his banners. Others assert, that Achaius, King of Scotland, first instituted this order, after having made the famous league, offensive and defensive, with Charlemagne, King of France. But although the thistle had been acknowledged as the symbol of the kingdom of Scotland from the reign of Achaius, yet some refer the beginning of this order to the reign of Charles VII. of France. Others place the foundation of it as low as the year 1500.

The chief and principal ensign is a gold collar, composed of thistles and sprigs of rue interlinked with amulets of gold, having pendent thereto the image of St. Andrew with his cross, and the motto, NEMO ME IMPUNE LACESSET.

The ordinary or common ensign worn by the knights is a star of four silver points, and over them a green circle, bordered and lettered with gold, containing the said motto, and in the centre is a thistle proper; all which is embroidered on their left breast, and worn with the collar, with a green ribband over the left shoulder, and brought under the right arm; pendent thereto is the image of St. Andrew, with his cross, in a purple robe, within an oval of gold enamelled vert, with the former motto: but sometimes they wear, encircled in the same manner, a thistle crowned.

About the time of the reformation, this order was dropped, till James II. of England resumed it, by creating eight knights: however, the revolution unsettled it again; and it lay neglected till Queen Anne, in 1703, restored it to the primitive design, of twelve knights of St. Andrew. King George I. in the first of his reign, confirmed the statutes signed by Queen Anne, with the addition of several more, among which was that of adding rays of glory to surround the figure of St. Andrew which hangs at the collar: and though from the reformation to George I. both elections and instalments had been dispensed with, his majesty ordered that chapters of election should, for the future, be held in the royal presence; to which end he ordered the great wardrobe to provide the knights brethren, and officers, with such mantles as the statutes of the said order appointed.

THLASPI, in botany, *bastard-cress*, a genus of the Tetradynamia Siliculosa class and order. Natural order of Siliquosæ or Cruciformes. Cruciferæ, Jussieu. Essential character: silicle emarginate, obcordate, many-seeded; valves boat-shaped, margined and keeled. There are fourteen species.

THOA, in botany, a genus of the Monoecia Polyandria class and order. Natural order of Urticæ, Jussieu. Essential character: calyx and corolla none; male, stamens numerous, at the joints of the spike; female, germs two, at the base of the male spike, one on each side, sessile; stigma three or four cleft: seed in a brittle shell, covered with a bristly web. There is only one species, *viz.* T. urens.

THOLES, in marine affairs, small pins driven perpendicularly into the gunwale of a boat, and serving to retain the oars in that space which is called the row-lock; sometimes there is only one pin to each oar, as in boats navigated in the Mediterranean Sea: in that case, the oar is retained upon the pin, by means of a strop, or of a cleat, with a hole through it, nailed on the side of the oar.

THOUINIA, in botany, so named in honour of Mons. André Thouin, fellow of the National Institute, and professor of Horticulture in the French Museum, a genus of the Pentandria Monogynia class and order. Natural order of Convolvuli, Jussieu. Essential character: corolla one-petalled, bell-shaped, inferior, hispid on the outside; style simple; drupe. There is but one species, *viz.* T. spectabilis, a native of Madagascar, where it was found by Commerson.

THONSCHIEFER, in mineralogy, slate, is divided into three sub-species: 1. The common argillaceous schistus, which is composed of silex, alumina, oxide of iron, and proportions of carbonated lime and magnesia: it is used for covering houses, and the straight-foliated bluish-grey varieties are employed as writing slates: the softer and more compact varieties are made into slate pencils. See SCHISTUS, also SLATE. 2. Hone slate, called by Kirwan novaculite: its colour is a greenish-grey, or smoke-grey, passing to olive and mountain-green. It occurs in mass, and has a glimmering lustre: its fracture in the great is slaty; in the small,

Now it is generally observed, that from the month of April, an east or south-east wind generally takes place, and continues with little interruption till towards the end of June. At that time, sometimes sooner and sometimes later, a westerly wind takes place; but as the causes producing the east wind are not removed, the latter opposes the west wind with its whole force. At the place of meeting, there is naturally a most vehement pressure of the atmosphere, and friction of its parts against one another; a calm ensues, and the vapours brought by both winds begin to collect, and form dark clouds, which can have little motion either way, because they are pressed almost equally on all sides. For the most part, however, the west wind prevails, and what little motion the clouds have is towards the east: whence the common remark in this country, that "thunder-clouds move against the wind." But this is by no means universally true: for if the west wind happens to be excited by any temporary cause before its natural period, when it should take place, the east wind will very frequently get the better of it; and the clouds, even although thunder is produced, will move westward. Yet in either case the motion is so slow, that the most superficial observers cannot help taking notice of a considerable resistance in the atmosphere.

When lightning acts with extraordinary violence, and breaks or shatters any thing, it is called a thunderbolt, which the vulgar, to fit it for such effects, suppose to be a hard body, and even a stone. But that we need not have recourse to a hard solid body, to account for the effects commonly attributed to the thunderbolt, will be evident to any one, who considers those of gunpowder, and the several chemical fulminating powders, but more especially the astonishing powers of electricity, when only collected and employed by human art, and much more, when directed and exercised in the course of nature.

When we consider the known effects of electrical explosions, and those produced by lightning, we shall be at no loss to account for the extraordinary operations vulgarly ascribed to thunderbolts. As stones and bricks struck by lightning are often found in a vitrified state, we may reasonably suppose, with Beccaria, that some stones in the earth, having been struck in this manner, gave occasion to the vulgar opinion of the thunderbolt.

Thunder-clouds are those clouds which are in a state fit for producing lightning and thunder. From Beccaria's exact and circumstantial account of the external appearances of thunder-clouds, the following particulars are extracted. The first appearance of a thunder storm, which usually happens when there is little or no wind, is one dense cloud, or more, increasing very fast in size, and rising into the higher regions of the air. The lower surface is black, and nearly level; but the upper finely arched, and well defined. Many of these clouds often seem piled upon one another, all arched in the same manner; but they are continually uniting, swelling, and extending their arches. At the time of the rising of this cloud, the atmosphere is commonly full of a great many separate clouds, that are motionless, and of odd whimsical shapes. All these, upon the appearance of the thunder-cloud, draw towards it, and become more uniform in their shapes as they approach; till, coming very near the thunder-cloud, their limbs mutually stretch towards one another, and they immediately coalesce into one uniform mass. These he calls adscititious clouds, from their coming in to enlarge the size of the thunder-cloud. But sometimes the thunder-cloud will swell, and increase very fast, without the conjunction of any adscititious clouds; the vapours in the atmosphere forming themselves into clouds wherever it passes. Some of the adscititious clouds appear like white fringes, at the skirts of the thunder-cloud, or under the body of it, but they keep continually growing darker and darker, as they approach to unite with it. When the thunder-cloud is grown to a great size, its lower surface is often ragged, particular parts being detached towards the earth, but still connected with the rest. Sometimes the lower surface swells into various large protuberances bending uniformly downward; and sometimes one whole side of the cloud will have an inclination to the earth, and the extremity of it nearly touch the ground. When the eye is under the thunder-cloud, after it is grown larger, and well formed, it is seen to sink lower, and to darken prodigiously; at the same time that a number of small adscititious clouds (the origin of which can never be perceived) are seen in a rapid motion, driving about in very uncertain directions under it. While these clouds are agitated with the most rapid motions, the rain commonly falls in the greatest plenty; and if the

agitation be exceedingly great, it commonly hails. While the thunder-cloud is swelling, and extending its branches over a large tract of country, the lightning is seen to dart from one part of it to another, and often to illuminate its whole mass. When the cloud has acquired a sufficient extent, the lightning strikes between the cloud and the earth, in two opposite places, the path of the lightning lying through the whole body of the cloud and its branches. The longer this lightning continues, the less dense does the cloud become, and the less dark its appearance; till at length it breaks in different places, and shows a clear sky. These thunder-clouds were sometimes in a positive as well as a negative state of electricity. The electricity continued longer of the same kind, in proportion as the thunder-cloud was simple and uniform in its direction: but when the lightning changed its place, there commonly happened a change in the electricity of the apparatus over which the clouds passed. It would change suddenly after a very violent flash of lightning; but the change would be gradual when the lightning was moderate, and the progress of the thunder-cloud slow. See Priestley's History of Electricity.

THYMBRA, in botany, a genus of the Didynamia Gymnospermia class and order. Natural order of Verticillatæ or Labiatæ. Essential character: calyx subcylindrical, two-lipped, scored on each side with a villose line; style semibifid. There are three species.

THYMUS, in botany, *thyme*, a genus of the Didynamia Gymnospermia class and order. Natural order of Verticillatæ or Labiatæ. Essential character: throat of the two-lipped calyx closed with villose hairs. There are twenty-two species.

THYNNUS, in natural history, a genus of insects of the order Hymenoptera: mouth horny, with an incurved mandible, the jaw short and straight; lip longer than the jaw, membranaceous at the tip, and trifid, the middle division emarginate; tongue very short, involute; four feelers, equal, filiform; antennæ cylindrical, the first joint thicker. There are four species: three of New Holland, and one of Africa. Specimens of them all are to be found in Sir Joseph Banks's museum.

TIARELLA, in botany, a genus of the Decandria Digynia class and order. Natural order of Succulentæ. Saxifragæ, Jussieu. Essential character: calyx five-parted; corolla five-petalled, inserted into the calyx; petals entire; capsule one-celled, two-valved, with one valve larger. There are two species, *viz.* T cordifolia, heart-leaved tiarella, and T. trifoliata, three-leaved tiarella, both natives of the northern parts of America and Asia.

TIDES, two periodical motions of the waters of the sea, called the flux and reflux, or the flow and ebb. The cause of the tides is the attraction of the sun and moon, but chiefly of the latter; the waters of the immense ocean, forgetful, as it were, of their natural quietus, move and roll in tides, obsequious to the strong attractive power of the moon, and weaker influence of the sun. See ASTRONOMY.

That the tides may have their full motion, the ocean in which they are produced ought to be extended from east to west 90°, or a quarter of a great circle of the earth, at least; because the places where the moon rises most, and most depresses the water, are at that distance from one another. Hence it appears, that it is only in the great oceans that such tides can be produced; and why, in the large Pacific ocean, they exceed those in the Atlantic ocean; hence also it is obvious, why the tides are not so great in the torrid zone, between Africa and America, where the ocean is narrower, as in the temperate zones on either side; and from this, also, we may understand why the tides are so small in islands that are very far distant from the shores. It is manifest, that, in the Atlantic ocean, the water cannot rise on one shore but by descending on the other; so that, at the intermediate distant islands, it must continue at about a mean height between its elevation on the one and on the other shore. As the tides pass over shoals, and run through streights into bays of the sea, their motion becomes more various, and their height depends on a great many circumstances. The tide that is produced on the western coast of Europe corresponds to the theory above described: thus, it is high water on the coast of Spain, Portugal, and the west of Ireland, about the third hour after the moon has passed the meridian: from thence it flows into the adjacent channels, as it finds the easiest passage. One current from it, for example, runs up by the south of England, and another comes in by the north of Scotland: they take a considerable time to move all this way, and it is high water sooner in the places to which they first come; and it begins to fall in those places, while the two currents are yet going on to others that are further in their course As they return, they are not able to raise

a tide; because the water runs faster off than it returns, till, by a new tide propagated from the ocean, the return of the current is stopped, and the water begins to rise again. The tide takes twelve hours to come from the ocean to London bridge; so that, when it is high water there, a new tide is already come to its height in the ocean; and, in some intermediate place, it must be low water at the same time. In channels, therefore, and narrow seas, the progress of the tides may be, in some respects, compared to the motion of the waves of the sea. It may be observed, that when the tide runs over shoals, and flows upon flat shores, the water is raised to a greater height than in the open and deep oceans that have steep banks; because the force of its motion cannot be broken, upon these level shores, till the water rises to a greater height. If a place communicates with two oceans (or two different ways with the same ocean, one of which is a readier and easier passage) two tides may arrive at that place in different times, which, interfering with each other, may produce a greater variety of phenomena.

An extraordinary instance of this kind is mentioned at Bathsha, a port in the kingdom of Tonquin in the East Indies, of northern latitude 20° 50′. The day in which the moon passes the equator, the water stagnates there without any motion: as the moon removes from the equator, the water begins to rise and fall once a day; and it is high water at the setting of the moon, and low water at her rising. This daily tide increases for about seven or eight days, and then decreases for as many days by the same degrees, till this motion ceases when the moon has returned to the equator. When she has passed the equator, and declines towards the south pole, the water rises and falls again, as before; but it is high water now at the rising, and low water at the setting of the moon.

Tide *tables*, are those which set forth the times of high water at sundry places, as they fall on the days of the full and change of the moon. These are common in many almanacs, particularly in White's Ephemeris, Nautical Almanac, &c.

Tide *waiters*, or Tidesmen, are inferior officers belonging to the custom-house, whose employment it is to watch or attend upon ships, until the customs be paid: they get this name from their going on board ships, on their arrival in the mouth of the Thames or other port, and so come up with the tide.

TIERCE, or Teirce, a measure of liquid things, as wine, oil, &c. containing the third part of a pipe, or forty-two gallons.

TIERCED, *tierce*, in heraldry, denotes the shield to be divided by any of the partition lines, as party, coupy, tranchy, or tailly, into three equal parts of different colours or metals.

TIGER. See Felis.

TILE *ore*, in mineralogy, a species of the copper genus, divided into two subspecies, *viz.* the earthy and indurated. The earth is of a hyacinth-red colour, passing through various shades to a reddish brown: it is intermediate between friable and solid, and occurs massive, disseminated, and incrusting copper pyrites. It slightly soils, is almost coherent, and some varieties incline to solid. It is found in veins, and is usually accompanied with native copper and malachite, and sometimes with red copper ore. The indurated tile-ore is in colour between a hyacinth-red and brownish red: it occurs massive and disseminated, internally glimmering. Before the blow-pipe it becomes black, but is infusible without addition: it contains from ten to fifty per cent. of copper: it occurs in veins, and is usually accompanied with copper pyrites, fibrous malachite, and iron ochre. It is found in many parts of Germany, in the copper works in Norway, in Siberia, and in Chili. The red varieties contain the greatest quantities of copper, and the brown the greatest quantity of iron. It occurs in almost every place where red copper-ore is found: its name is derived from its colour, and the name of the sub-species from its state of cohesion.

TILIA, in botany, *lime-tree*, a genus of the Polyandria Monogynia class and order. Natural order of Columniferæ. Tiliaceæ, Jussieu. Essential character: calyx five-parted; corolla five-petalled; capsule coriaceous, globular, five-celled, five-valved, opening at the base, one-seeded. There are four species, among which is the T. Europæa, European lime-tree, or linden, is a tall upright tree, with smooth spreading branches, thickly clothed with alternate, heart-shaped, smooth serrate leaves, pointed at the end, oblique at the base, glaucous beneath, and the veins, where they branch off from the nerve, being furnished with a tuft of glandular wool, as in the laurustinus; the flowers, which are delightfully fragrant, especially at night, come forth in July, in umbels or cymes, on long axillary peduncles; calyx green, with a downy edge; petals yellowish, concave; stamens filiform; stigma five-

cleft; germ villose, depressed; capsule smooth, with from four to eight unequal angles, commonly one-celled and one-seeded.

TILLÆA, in botany, so named in honour of Michael Angelo Tilli, professor of botany at Pisa, a genus of the Tetrandria Tetragynia class and order. Natural order of Succulentæ. Sempervivæ, Jussieu. Essential character: calyx three or four-parted; petals three or four, equal; capsule three or four, many seeded. There are eight species.

TILLER *of a ship*, a strong piece of wood fastened in the head of the rudder, and in small ships and boats called the helm. In ships of war, and other large vessels, the tiller is fastened to the rudder in the gun room: and to the other end there are ropes fastened, which pass upwards to the quarter-deck, where the ship is steered by means of a wheel.

TILLANDSIA, in botany, so named in memory of Elias Tillandsius, professor of physic at Aboa, a genus of the Hexandria Monogynia class and order. Natural order of Coronariæ. Bromeliæ, Jussieu. Essential character: calyx trifid, permanent; corolla trifid, bell-shaped; capsule one-celled; seeds comose. There are sixteen species.

TILT *boat*, a boat covered with a tilt; that is, a cloth or tarpaulin, sustained by hoops, for the sheltering of passengers.

TIMBER, includes all kinds of felled and seasoned woods. Of all the different kinds, known in Europe, oak is the best for building; and even when it lies exposed to air and water, there is none equal to it. Fir-timber is the next in degree of goodness for building, especially in this country, where they build upon leases. It differs from oak in this, that it requires not much seasoning, and therefore no great stock is required before hand. Fir is used for flooring, wainscoting, and the ornamental parts of building within doors. Elm is the next in use, especially in England and France; it is very tough and pliable, and therefore easily worked; it does not readily split; and it bears driving of bolts and nails better than any other wood; for which reason it is chiefly used by wheel-rights and coach-makers, for shafts, naves, &c. Beech is also used for many purposes; it is very tough and white when young, and of great strength, but liable to warp very much when exposed to the weather, and to be worm-eaten when used within doors; its greatest use is for planks, bedsteads, chairs, and other household goods. Ash is likewise a very useful wood, but very scarce in most parts of Europe; it serves in buildings, or for any other use, when screened from the weather; handspikes and oars are chiefly made of it. Wild chestnut-timber is by many esteemed to be as good as oak, and seems to have been much used in old buildings; but whether these trees are more scarce at present than formerly, or have been found not to answer so well as was imagined, it is certain this timber is now but little used. Walnut-tree is excellent for the joiner's use, it being of a more curious brown colour than beech, and not so subject to the worms. The poplar, abel, and aspen trees, which are very little different from each other, are much used instead of fir; they look well, and are tougher and harder.

The goodness of timber not only depends on the soil and situation in which it stands, but likewise on the season wherein it is felled. In this people disagree very much; some are for having it felled as soon as its fruit is ripe, others in the spring, and many in the autumn. But as the sap and moisture of timber is certainly the cause that it perishes much sooner than it otherwise would do, it seems evident that timber should be felled when there is the least sap in it, *viz.* from the time that the leaves begin to fall till the trees begin to bud. This work usually commences about the end of April in England, because the bark then rises most freely; for where a quantity of timber is to be felled, the statute requires it to be done then, for the advantage of tanning.

The ancients chiefly regarded the age of the moon in felling their timber; their rule was to fell it in the wain, or four days after the new moon, or sometimes in the last quarter. Pliny advises it to be in the very article of the change, which happening to be in the last day of the winter solstice, the timber, says he, will be incorruptible. Timber should likewise be cut when of a proper age; for when it is either too young or too old, it will not be so durable as when cut at a proper age. It is said that oak should not be cut under sixty years old, nor above two hundred. Timber trees, however, should be cut in their prime, when almost fully grown, and before they begin to decay; and this will be sooner or later, according to the dryness or moistness of the soil where the timber grows; as also according to the size of the trees; for there is no fixed rules in felling of timber, experience and judgment must direct here as in most other cases.

After timber has been felled and sawed, it must be seasoned: for which purpose some advise it to be laid up in a very dry airy place, yet out of the wind and sun, or at least free from the extremities of either; and that it may not decay, but dry evenly, they recommend it to be daubed over with cow-dung. It must not stand upright, but lie all along, one piece over another, only kept apart by short blocks interposed, to prevent a certain mouldiness, which they are otherwise apt to contract in sweating on one another; from which arises frequently a kind of fungus, especially if there be any sappy parts remaining. Others advise the planks of timber to be laid for a few days in some pool or running stream, in order to extract the sap, and afterwards to dry them in the sun or air. By this means, it is said, they will be prevented from either chopping, casting, or cleaving, but against shrinking there is no remedy. Some again are for burying them in the earth, others in a heat; and some for scorching and seasoning them in fire, especially piles, posts, &c. which are to stand in water or earth. The Venetians first found out the method of seasoning or charring by fire; which is done after this manner: they put the piece to be seasoned into a strong and violent flame; in this they continually turn it round by means of an engine, and take it out where it is every where covered with a black coaly crust: the internal part of the wood is thereby so hardened, that neither earth nor water can damage it for a long time afterwards.

To measure round timber, let the mean circumference be found in feet and decimals of a foot: square it, multiply this square by the decimal 0.079577, and the product by the length. Example. Let the mean circumference of a tree be 10.3 feet, and the length 24 feet. Then $10.3 \times 10.3 \times 0.079577 \times 24 = 202.615$, the number of cubical feet in the tree. The foundation of this rule is, that when the circumference of a circle is 1, the area is 0.0795774715, and that the areas of circles are as the squares of their circumferences. But the common way used by artificers for measuring round timber differs much from this rule. They call one fourth part of the circumference the girth, which is by them reckoned the side of a square, whose area is equal to the area of the section of the tree; therefore they square the girth, and then multiply by the length of the tree. According to their method, the tree of the last example would be computed at 159.13 cubical feet only.

In speaking of the strength of timber, or of several kinds of wood, Mr. Emerson says that, from experiments which he has made, a piece of good oak, an inch square and a yard long, supported at both ends, will bear in the middle for a short time about 330*lbs*. avoirdupois, but will immediately break with a greater weight. Such a piece, he adds, ought not in practice to be trusted for any length of time with more than one-third, or perhaps one-fourth, part of the weight; he then gives a table of the different degrees of strength of several sorts of wood. Other writers, who have entered at large on the subject, have considered the strength of materials, timber, &c. as subject to four different kinds of strain. 1. As they may be torn asunder, as in the case of ropes, stretchers, king-posts, tye-beams, &c. 2. As they may be crushed, as in the case of pillars, posts, and truss-beams. 3. As they may be broken across, as happens to a joist or lever of any kind. 4. As they may be wrenched or twisted, as in the case of the axle of a wheel, the nail of a press, &c. It would carry us much beyond the limits of this work to enter at large on these several subjects, we shall therefore confine ourselves to some observations on the strains upon timber, which may be practically useful.

With regard to the cohesion of wood, we may premise, 1. that the wood immediately surrounding the pith, or heart, of the tree is the weakest, and its inferiority is so much more remarkable as the tree is older. This at least is asserted by Muschenbroek as the result of experiments; but M. Buffon says, that his experience has taught him that the heart of a sound tree is the strongest; but he gives no instances. It is certain, from many observations on very large oaks and firs, that the heart is much weaker than the exterior parts. 2. The wood next the bark, commonly called the white or blea, is also weaker than the rest; and the wood gradually increases in strength as we recede from the centre to the blea. 3. The wood is stronger in the middle of the trunk than at the springing of the branches, or at the root; and the wood of the branches is weaker than that of the trunk. 4. The wood of the north side of all trees which grow in our European climates is the weakest, and that of the south-east side is the strongest; and the difference is most remarkable in hedge row trees, and such

as grow singly. The heart of a tree is never in its centre, but always nearer to the north side, and the annual coats of wood are thinner on that side. In conformity with this, it is a general opinion of carpenters, that timber is stronger whose annual plates are thicker. The trachea, or air-vessels, are weaker than the simple ligneous fibres. These air-vessels are the same in diameter and number of rows in trees of the same species, and they make the visible separation between the annual plates. Therefore, when these are thicker, they contain a greater proportion of the simple ligneous fibres. 5. All woods are more tenacious while green, and lose very considerably by drying after the trees are felled. The only author who has put it in our power to judge of the propriety of his experiments, is Muschenbroek. He has described his method of trial minutely, and it seems unexceptionable. The woods were all formed into slips fit for his apparatus, and part of the slip was cut away to a parallelopiped of one-fifth of an inch square, and therefore one-twenty-fifth of a square inch in section.

The absolute strengths of a square inch were as follow:

	lbs.
Locust tree	20,100
Jujeb	18,500
Beech, oak	17,300
Orange	15,500
Alder	13,900
Elm	13,200
Mulberry	12,500
Willow	12,500
Ash	12,000
Plum	11,800
Elder	10,000
Pomegranate	9,750
Lemon	9,250
Tamarind	8,750
Fir	8,330
Walnut	8,130
Pitch pine	7,650
Quince	6,750
Cypress	6,000
Poplar	5,500
Cedar	4,880

M. Muschenbroek has given a very minute detail of the experiments on the ash and the walnut, stating the weights which were required to tear asunder slips taken from the four sides of the tree, and on each side in a regular progression from the centre to the circumference. The numbers of this table corresponding to these two timbers may therefore be considered as the average of more than fifty trials made of each; and he says that all the others were made with the same care. We cannot therefore see any reason for not confiding in the results; yet they are considerably higher than those given by some other writers. M. Pitot says, on the authority of his own experiments, and of those of M. Parent, that sixty pounds will just tear asunder a square line of sound oak, and that it will bear fifty with safety. This gives 8,640 for the utmost strength of a square inch, which is much inferior to Muschenbroek's valuation. We may add to these,

Ivory	16,270
Bone	5,250
Horn	8,750
Whalebone	7,500
Tooth of sea-calf	4,075

The reader will surely observe, that these numbers express something more than the utmost cohesion; for the weights are such as will very quickly, that is, in a minute or two, tear the rods asunder. It may be said in general, that two-thirds of these weights will sensibly impair the strength after a considerable while, and that one-half is the utmost that can remain suspended at them without risk for ever; and it is this last allotment that the engineer should reckon upon in his constructions. There is, however, considerable difference in this respect. Woods of a very straight fibre, such as fir, will be less impaired by any load which is not sufficient to break them immediately. According to Mr. Emerson, the load which may be safely suspended to an inch square, is as follows:

Iron	76,400
Brass	35,600
Hempen rope	19,600
Ivory	15,700
Oak, box, yew, plum-tree	7,850
Elm, ash, beech	6,070
Walnut, plum	5,360
Red fir, holly, elder, plane, crab	5,000
Cherry, hazle	4,760
Alder, asp, birch, willow	4,290
Lead	430
Freestone	914

He gives us a practical rule, that a cylinder whose diameter is *d* inches, loaded to one-fourth of its absolute strength, will carry as follows:

	cwt.
Iron	135
Good rope	22
Oak	14
Fir	9

Experiments on the transverse strength of bodies are easily made, and accordingly are very numerous, especially those made on timber, which is the case most common and most interesting. But in this great number of experiments, there are very few from which we can draw much practical information. The experiments have in general been made on such small scantlings, that the unavoidable natural inequalities bear too great a proportion to the strength of the whole piece. Accordingly, when we compare the experiments of different authors, we find them differ enormously, and even the experiments by the same author are very anomalous. The completest series that we have yet seen is that detailed by Belidore in his "Science des Ingenieurs." They are contained in the following table. The pieces were sound, even-grained oak. The column *b*, contains the breadth of the pieces in inches; the column *d*, contains their depth; the column *l*, contains their lengths; column *p*, contains the weights (in pounds) which broke them when hung on their middles; and *m* is the column of averages or mediums.

N.	*b.*	*d.*		*p.*	*m.*	
1	1	1	18	400, 415, 405	406	The ends lying loose.
2	1	1	18	600, 600, 624	608	The ends firmly fixed.
3	2	1	18	810, 795, 812	805	Loose.
4	1	2	18	1570, 1580, 1590	1580	Loose.
5	1	1	36	185, 195, 180	187	Loose.
6	1	1	36	285, 280, 285	283	Fixed.
7	2	2	36	1550, 1620, 1585	1585	Loose.
8	$1\frac{2}{3}$	$2\frac{1}{3}$	36	1665, 1675, 1640	1660	Loose.

By comparing Experiments 1 and 3, the strength appears proportional to the breadth. Experiments 3 and 4, show the strength proportional to the square of the depth. Experiments 1 and 5, show the strength nearly in the inverse proportion of the lengths, but with a sensible deficiency in the longer pieces. Experiments 5 and 7, show the strengths proportional to the breadths and the square of the depths. Experiments 1 and 7, show the same thing, compounded with the inverse

proportion of the length; the deficiency relative to the length is not so remarkable here. Experiments 1 and 2, and Experiments 5 and 6, show the increase of strength, by fastening the ends, to be in the proportion of 2 to 3. The theory gives the proportion of 2 to 4. But a difference in the manner of fixing may produce this deviation from the theory, which only supposed them to be held down at places beyond the props, as when a joist is held in the walls, and also rests on two pillars between the walls. We shall here give an abstract of M. Buffon's experiments. He relates a great number which he had prosecuted during two years on small battens. He found that the odds of a single layer, or part of a layer, more or less, or even a different disposition of them, had such influence, that he was obliged to abandon this method, and to have recourse to the largest beams that he was able to break. The following table exhibits one series of experiments on bars of sound oak, clear of knots, and four inches square. This is a specimen of all the rest. Column 1, is the length of the bar in feet clear between the supports. Column 2, is the weight of the bar (the second day after it was felled) in pounds. Two bars were tried of each length. Each of the first three pairs consisted of two cuts of the same tree. The one next the root was always found the heaviest, stiffest, and strongest. Indeed, M. Buffon says, that this was invariably true, that the heaviest was always the strongest; and he recommends it as a sure rule for the choice of timber. He finds that this is always the case when the timber has grown vigorously, forming very thick annual layers. But he also observes, that this is only during the advances of the tree to maturity; for the strength of the different circles approaches gradually to equality during the tree's healthy growth, and then it decays in these parts in a contrary order. Our toolmakers assert the same thing with respect to beech; yet a contrary opinion is very prevalent; and wood with a fine, that is, a small grain, is frequently preferred. Perhaps no person has ever made the trial with such minuteness as M. Buffon, and much deference is thought to be due to his opinion. Column 3, is the number of pounds necessary for breaking the tree in the course of a few minutes. Column 4, is the inches which it bent down before breaking. Column 5, is the time at which it broke.

1	2	3	4	5
7	60	5350	3.5	29
	56	5275	4.5	22
8	68	4600	3.75	15
	63	4500	4.7	13
9	77	4100	4.85	14
	71	3950	5.5	12
10	84	3625	5.83	15
	82	3600	6.5	15
12	100	3050	7.	
	98	2925	8.	

Mr. George Smart, well known for his practical knowledge of mechanics, in almost every department, says, that after making many experiments on timber, and comparing them with those of Belidore, Buffon, &c. the differences were so great, that it would be wasting time to enumerate them. He therefore mentions some useful observations necessary to be known by all those mechanics who use timber; and points out some evident errors in a table of Belidore's, supposed to be the result of the best set of experiments ever produced in transverse strains. He tells us, that a bar of wood, thirty-six inches long, and one inch square, supported at the ends by two props, will break with a weight of 187 pounds on the middle, if it is loose at the ends; but if the ends are firmly fixed, it will require 283 pounds to break it. "This appeared to me," says Mr. Smart, "so great an error, that I was induced to put little or no confidence in many of his experiments; and, in consequence, I made two laths of fir, of the same dimensions, one with a strong shoulder at each end, to prevent it bending, which having firmly fixed in a frame, it carried a weight more than ten times greater than that which was loose."

The fibres of timber requiring so great a force to tear them asunder in a vertical direction, and being easily broken by a transverse strain, when compared to that of a rope carrying nearly an equal weight in all directions, opens a wide field for useful experiments. All timber trees have their annual circles, or growths, which vary greatly according to the soil and exposure to the sun. The north-east side of the trees (being much smaller in the grain than the other parts which are more

exposed to the sun) is strongest for any column that has a weight to support in a vertical direction; because its hard circles, or tubes, are nearer each other, and the area contains a greater quantity of them; nor are they so liable to be compressed by the weight, or to slide past each other, as when they are at a greater distance. On the other hand, this part of the tree is not fit for a transverse strain; because the nearer the hard circles are to each other, the easier the beam will break, there being so little space between them, that one forms a fulcrum to break the other upon; but that part of a tree, the tubes of which are at a greater distance, or of a larger grain, is more elastic, and requires a greater force to break it; because the outside fibre on the convex side cannot snap till the next one is pressed upon it, which forms the fulcrum to break it on. It is generally observed in large timbers, such as masts, that the fracture is seldom on the convex, but usually on the concave side; which is owing to the fibres on the concave side being more readily forced past each other, and those on the convex being so difficult to be torn asunder, that they cannot snap, in consequence of the largeness of the segment of the circle they describe when on the strain. The curve described by the inner layers of the wood being so large, and indeed little less than a straight line, cannot form a fulcrum to break the outer ones upon; and as the convex side, or that on which the fibres are extended, ought to be always free from any mortise or incision on the outside, the strength decreases as it approaches the centre. Mr. Smart has, in a paper in the "Repertory," given directions how to cut and join timber so as to have the greatest strength, and to turn to the greatest advantage, of having the best part of the tree in the place where the hardness and strength are most wanted, *viz.* in the corners which form the abutments; whereas the same tree, squared into a parallel beam, would have been much smaller, and the soft or sappy parts of the wood exposed to the action of the air and moisture. In flush framing it is observable, that the failure of all timber in old buildings has commenced much sooner than they otherwise would have done, owing to the sappy wood being at the corners of the principal beams, which soon decays, as its spongy quality attracts the moisture; whereas the heart, especially of oak, will be as sound as the first day it was used.

As all beams take their weight horizontally, or on any transverse bearing, have their principal strain on the upper and lower surface, every workman ought to guard against having sap in beams, because, if they do not immediately decay, they shrink, so as to let loose all the framing, and soon cripple the building or machine; but on Mr. Smart's plan, the sappy part of the wood is excluded from what would cause its decay, and the timber increased in quantity is considerably more than the extra labour and expense.

Timber *trees*, in law, are properly oak, ash, and elm. In some particular countries, by local custom, other trees being commonly there made use of for building, are considered as timber. Of these, being part of the freehold, larceny cannot be committed; but, if they be severed at one time, and carried away at another, then the stealing of them is larceny. And by several late statutes, the stealing of them in the first instance is made felony, or incurs a pecuniary forfeiture. For the better preservation of roots, shrubs, and plants, it is enacted, by 6 George III. c. 48, that every person convicted of damaging, destroying, or carrying away any timber-tree, or trees, or trees likely to become timber, without consent of the owner, &c. shall forfeit for the first offence not exceeding 20*l.* with the charges attending; and on non-payment shall be committed for not more than twelve, nor less than six months; for the second offence, a sum not exceeeing 30*l.* and on non-payment shall be committed for not more than eighteen, and not less than twelve months; and for the third offence, is to be transported for seven years. All oak, beech, chesnut, walnut, ash, elm, cedar, fir, asp, lime, sycamore, and birch trees, shall be deemed and taken to be timber trees, within the true meaning and provision of this act. Persons convicted of plucking up, spoiling, or taking away any root, shrub, or plant, out of private cultivated ground, shall forfeit, for the first offence, any sum not exceeding 40*s.* with the charges; for the second offence, a sum not exceeding 5*l.* with the charges; and for the third offence, are to be transported for seven years. A power is given to justices of the peace to put this act in execution.

TIME, a succession of phenomena in the universe; or a mode of duration, marked by certain periods or measures, chiefly by the motion and revolution of the sun. The idea of time, in the general, Mr. Locke observes, we acquire by

considering any part of infinite duration as set out by periodical measures: the idea of any particular time, or length of duration, as a day, an hour, &c. we acquire, first, by observing certain appearances at regular, and, seemingly, at equidistant periods. Now, by being able to repeat those lengths or measures of time, as often as we will, we can imagine duration, where nothing really endures or exists; and thus we imagine to-morrow, next year, &c. Some of the latter school-philosophers define time to be the duration of a thing, whose existence is neither without beginning nor end; by which time is distinguished from eternity. Time is distinguished into absolute and relative. Absolute time, is time considered in itself, and without any relation to bodies, or their motions. This flows equally, *i e.* never proceeds faster or slower, but glides on in a constant, equable tenor. Relative time, is the sensible measure of any duration, by means of motion. For, since that equable flux of time does not affect our senses, nor is any way immediately cognizable thereby, there is a necessity for calling in the help of some nearly equable motion to a sensible measure, whereby we may determine its quantity by the correspondency of the parts of this with those of that. Hence, as we judge those times to be equal which pass while a moving body, proceeding with an equable velocity, passes over equal spaces; so we judge those times to be equal, which flow while the sun, moon, and other luminaries, perform their revolutions, which, to our senses, are equal. But since the flux of time cannot be accelerated, nor retarded, whereas all bodies move sometimes faster and sometimes slower, and there is, perhaps, no perfectly equable motion in all nature, it appears hence to follow, that absolute time should be something truly and really distinct from motion. But, according to Lucretius:

"Time, of itself, is nothing, but from thought
Receives its rise; by labouring fancy wrought
From things consider'd, whilst we think on some
As present, some as past, or yet to come.
No thought can think on time, that's still confest,
But thinks on things in motion, or at rest."

Time *astronomical*, is that taken purely from the motion of the heavenly bodies, without any other regard.

Time *civil*, is the former time accommodated to civil uses, and formed and distinguished into years, months, days, &c.

Time, in music, is an affection of sound, whereby we denominate it long or short, with regard to its continuance in the same degree of time.

TIN, in mineralogy, a genus of metals, of which there are three species: 1. Tin-pyrites; colour intermediate between steel-grey and brass-yellow; but usually more inclined to the first; it occurs massive and disseminated; internally it is glistening, sometimes shining, and seldom passing into splendent; its lustre is metallic; it is brittle, and the specific gravity is somewhere between 4.3 and 4.8. Before the blow-pipe, it gives out a sulphureous odour, and melts easily, without being reduced, into a black scoria. It communicates a yellow or green colour to borax. It consists of

Tin	34
Copper	36
Iron	3
Sulphur	25
Earth	2
	100

It is found at Wheal-rock and St. Agnes in Cornwall, where it occurs in a vein about nine feet wide, accompanied with copper pyrites and brown blende.

2. Tin-stone, which is hard, brittle, and very heavy, the specific gravity being from 5.8 to 6.9 or 7. Before the blowpipe it decrepitates, becomes paler, and, where it rests on the charcoal, is reduced. When roasted, it is converted into a grey oxide. A specimen, analysed by Klaproth, contained

Tin	77.50
Iron	0.25
Oxygen	21.50
Silica	.75
	100.00

It occurs only in primitive rocks, as granite, gneiss, mica-slate, and clay-slate, and is said to be the oldest of all the metals. It occurs either disseminated in the rock, or in beds, or veins. It is usually

accompanied with quartz, mica, &c. and is also found in great quantities in alluvial land. The greater part of the English, much of the Spanish, and the greater proportion of that from India, occurs in that situation.

Tin is not found in many countries; but where it exists at all, it is in very considerable quantities. In Europe there are only three tin districts: the first is in Saxony and Bohemia; the second in Cornwall; and the third is that of Gallicia, on the borders of Portugal. It is found in many parts of Asia, and in South America. It is worked as an ore of tin, and from it all the tin of commerce is obtained. Its name is derived from the quantity of tin which it affords, and its unmetallic aspect.

3. Cornish tin-ore, or wood tin; which, like the last, is very heavy; before the blow-pipe it is infusible; it consists of about 63 parts of tin, with iron and arsenic. It has hitherto been found only in Cornwall, and there in alluvial land. It is very like brown hematite, from which it is distinguished by its colour, its rolled pieces, greater hardness, and higher specific gravity. We now turn to tin, in a chemical view.

Tin is a metal of a silver-white colour, very ductile, and malleable, gives out, while bending, a crackling noise, is fusible at a heat much less than that of ignition, is soluble in muriatic acid, and, by dilute nitric acid, is rapidly converted into a white oxide. Tin has been known from the earliest ages. It was much employed by the Egyptians in the arts, and by the Greeks as an alloy with other metals. Pliny speaks of it under the name of white lead, as a metal well known in the arts, and even applied in the fabrication of many ornaments of luxury. He ascribes to the Gauls the invention of the art of tinning, or covering other metals with a thin coat of tin. The alchemists were much employed in their researches concerning tin, and gave it the name of Jupiter, from which the salts, or preparations of tin, were called jovial. Since their time, the nature and properties of tin have been particularly investigated by many chemists, and it has proved the subject of some important discoveries in chemical science. Tin exists in nature in three different states. 1. It is found native; 2. In the state of oxide; and, 3. In that of sulphurated oxide. Native tin is in brilliant plates, or regularly crystallized. The native oxide of tin, which is the most common ore of this metal, exists under a variety of forms. It is generally found crystallized. The sulphuret of tin is of a pale, or dark-grey colour, and, when pure, has some resemblance to an ore of silver. To obtain the metal from its ores, they are first roasted, and then treated with a flux, to reduce the metal. After the ore is roasted, it fuses readily with three times its weight of black flux, and a little decrepitated muriate of soda. In the humid way, native tin may be dissolved in nitric acid, which readily oxidates, and reduces it to the state of white powder, which is an oxide of tin; and if it contain iron and copper, these two metals remain in the solution. Tin is of a white colour, nearly as brilliant as silver. The specific gravity of tin is nearly 7.3. It is one of the softest of the metals. It is extremely flexible, and so malleable, that it can be easily beaten out in plates to $\frac{1}{1000}$ part of an inch, which is the thickness of tinfoil. It has little elasticity or tenacity. A wire of this metal, about one-tenth of an inch in diameter, supports a weight of about thirty pounds, without breaking. Tin is susceptible of very considerable expansion, by means of caloric, and on this account it has been proposed to employ it as a pyrometer. Tin is one of the most fusible of the metals, and melts at the temperature of 442°; but it requires a very high temperature to raise it in vapour. If it be allowed to cool slowly, and when the surface becomes solid by pouring out part of the liquid metal, crystals are formed, composed of a great number of small needles. Tin is a good conductor of electricity. It possesses a peculiar odour, which is communicated to the hands by friction. It has also a perceptible taste. When this metal is exposed to the air, it is soon tarnished, and assumes a greyish white colour; but it undergoes no further change. When it is melted in an open vessel, it is soon covered with a greyish pellicle, which is the commencement of the oxidation of the metal. When this pellicle is removed, another forms, and so on successively, till the whole is oxidated. By continuing the heat, and by agitation, the process goes on more rapidly, and the metal is converted into a whitish powder. This oxide contains about twenty parts of oxygen in 100 of the metal. With the addition of lead, to promote the oxidation, this oxide is the putty of tin. It contains about two parts of oxide of lead, and one part of oxide of tin. But when tin is strongly heated, it is converted into a fine

white oxide, which, during the process, gives out a vivid white flame. This oxide is condensed in the cold, and crystallizes in shining, transparent needles.

Tin combines with two proportions of oxygen, thus forming two oxides. The yellow oxide, which has the smaller proportion of oxygen, may be prepared by dissolving tin in nitric acid diluted with water, without the aid of heat. By precipitating the oxide with pure potash, it is obtained in the form of a yellowish powder. Its component parts are,

Oxygen	20
Tin	80
	100

By dissolving tin in concentrated nitric acid, with the assistance of heat, the whole is converted with effervescence into a white powder, which falls to the bottom of the vessel. The component parts of this oxide are 28 oxygen, and 72 of tin.

Phosphorus combines very readily with tin, by projecting bits of phosphorus on melted tin in a crucible. A phosphuret of tin is thus obtained, which crystallizes on cooling. This compound is of a silvery white colour, may be cut with a knife, and extended under the hammer, but soon separates into plates. Sulphur combines very readily with tin, by adding the sulphur to the metal while in a state of fusion. This compound forms a greyish or bluish matter, which has a metallic lustre, a lamellated structure, and crystallizes in cubes, or in octahedrons. It is decomposed by acids with effervescence. The component parts are, according to Bergman,

Tin	80
Sulphur	20
	100

If equal parts of oxide of tin and sulphur be fused together in a retort, sulphurous acid, and some sulphur, are disengaged, and there remains in the vessel a compound of a brilliant, golden colour. It crystallizes in six-sided plates. It is not acted on by the acids. When it is strongly heated, it gives out sulphurous acid and sulphur, and there remains behind a black mass, which is sulphuret of tin. This compound, which is a sulphurated oxide of tin, was formerly distinguished by the name of aurum, musivum, musicum, or mosaicum. The component parts of this sulphurated oxide of tin are,

Oxide of tin	60
Sulphur	40
	100

Tin enters into combination with many of the metals, and forms alloys with them, some of which are of great importance. It also combines with acids, and forms salts.

Of the alloys, the most important is that of tin and copper, with some other additions, which forms bronze, bell-metal, speculum metal, &c. The alloy of tin and lead, in equal parts, forms plumbers' solder. The alloy of tin, lead, and bismuth, in the proportions of 3, 5, and 8, forms a compound that melts in a heat somewhat less than that of boiling water. The amalgam of mercury with tin is used in silvering of mirrors. Pewter is an alloy of tin and lead, which was formerly very much used, more so than any other metallic alloy, being the common material for plates, dishes, and other domestic utensils. Its use now is almost universally superseded by pottery, which is lighter, more readily kept clean, and much cheaper, though certainly less durable, on account of the brittleness of the latter. The name of pewter has been given to any malleable white alloy, into which tin largely enters; and its composition is so various, that hardly any two manufacturers employ precisely the same ingredients, and the same proportions. The finest kind of pewter contains no lead whatever, but consists of tin with a small alloy of antimony, and sometimes a little copper, and in all the superior kinds of pewter, the tin forms by far the greater part of the mixture. Pewter may be used for vessels containing wine, and even vinegar, provided there be from 80 to 82 parts of tin in the alloy, without the smallest danger; hence its use as a measure. The specific gravity of a mixture of tin and lead is less than the mean specific gravity of the two metals separately.

Tin is much used, particularly in the state of very thin leaves: it is then called

tin-foil. This is made from the finest tin, first cast into an ingot, then laminated to a certain extent, and afterwards beat out with a hammer Tin is used for tinning copper, iron, &c. and the salts of tin are employed in dying.

TIN *plate, tinning.* Tin combines with iron, and adheres strongly to its surface, forming a thin covering. This is one of the most useful combinations of tin, for it renders the iron fit for a great many valuable purposes, for which, otherwise, on account of its strong tendency to oxidation, or rusting, it would be totally inapplicable. This is well known by the name of tin-plate, or white iron. The process of tinning iron is the following: the plates of iron being reduced to the proper thickness, are cleaned by means of a weak acid. For this purpose the surface is first cleaned with sand, to remove any rust that may have formed. They are then immersed in water, acidulated with a small quantity of sulphuric acid, in which they are kept for twenty-four hours, and occasionally agitated. They are then well rubbed with cloths, that the surface may be perfectly clean. The tin is fused in a pot, the surface of which is covered with an oily or resinous matter, to prevent its oxidation.

The plates of iron are then immersed in the melted tin, and are either moved about in the liquid metal, or are dipped several different times. They are then taken out, and rubbed with saw-dust or bran, to remove the impurities from the surface.

TINCTURE, is commonly understood to be a coloured infusion of any substance in alcohol. It is a preparation much employed in PHARMACY, with many articles of the MATERIA *medica* (which see), particularly vegetable barks, aromatics of all kinds, and many of the resins and gum resins, which yield to alcohol, by infusion, that part of their substance in which most of the medicinal virtue resides.

TINCTURE, in heraldry, the hue or colour of any thing in coat armour, under which denomination may also be included the two metals, *or* and *argent*, because they are often represented by yellow and white.

TIPHIA, in natural history, a genus of insects of the order Hymenoptera. Mouth with a membranaceous rounded jaw, the mandible arched and acute; no tongue; four feelers, filiform, unequal, and inserted in the middle of the lip; antennæ filiform; short, convolute; sting concealed within the abdomen. There are about twenty-seven species, in two divisions; A. jaw vaulted; lip membranaceous, emarginate. B. jaw rounded; lip horny, three-toothed.

TIPULA, in natural history, *crane-fly*, a genus of insects of the order Diptera. Mouth with a very short membranaceous proboscis, the back grooved and receiving a bristle; two feelers, incurved, filiform, and longer than the head; the antennæ are mostly filiform There are nearly one hundred and fifty species, in two sections, distinguished by their wings. The insects in the division A have their wings expanded; those in B have them incumbent.

Most of the insects of this genus are very like the gnat; they feed on various substances: the larvæ are without feet, soft, and cylindrical, with a truncate toothed head; and feed on the roots of plants: the pupa is cylindrical, two-horned before, and toothed behind. The largest of the European tipulæ is T. rivosa; it is found frequently an inch and half in body, and is distinguished by the colour of its wings, which are transparent, with large dusky undulations, intermixed with white towards the rib, or upper edge. This insect proceeds from a greyish larva, found beneath the roots of grass in meadows, gardens, &c. and in the months of July and August it changes into a lengthened chrysalis, out of which, in September, proceeds the complete animal. This is known by the title of long-legs, and is frequently seen in houses during autumnal evenings, when, if it be possible, it will destroy itself by flying into the flame of a lighted candle. This propensity is common to many insects. T. tritici of Europe is a very minute insect. The antennæ are moniliform, longer than the thorax; legs very long. The larva is found in the ears of wheat, to which it is very injurious.

The Hessian fly belongs to this Linnæan genus: it has been described by T. Say, in the Journal of the Academy of Natural Sciences, under the name of Cecidomyia destructor.

TITANIUM, is a metal of a copper red colour, very difficult of fusion, soluble in muriatic acid, from which it may be precipitated by a tincture of galls. This metal was discovered in 1793, by Klaproth. He obtained it from a mineral called red schorl. In this mineral he found the oxide of a metal different from any other then known. To this, from Meriachan in Cornwall, where it was found, he gave the name of menachanite,

but he had not succeeded in reducing it to the metallic state. Klaproth afterwards analysed the menachanite, and found that it was precisely the same as the oxide of the metal which he discovered in red schorl. To this metal he gave the name of titanium. This metal has been found only in the state of oxide. Red schorl consists entirely of this oxide. It has been found in different countries, as in Spain, France, and Hungary. It is disseminated in the fine specimens of rock-crystal which are brought from Madagascar, crystallized in long brilliant needles; the form of the primitive crystal being a six-sided prism with two-sided summits; that of the molecule is a triangular prism, with right angled isosceles bases. It is of a red colour, of different shades. It is brittle, but the fragments are so hard as to scratch glass. The specific gravity is from 4.1 to 4.2. The other mineral, to which Klaproth has given the name of titanite, is composed of oxide of titanium, silica, and lime, nearly in equal proportions. Its specific gravity is 3.5. Titanium was obtained by Vauquelin, by reducing the native red oxide. He mixed together 100 parts of this oxide with 50 of calcined borax, and 50 of charcoal, formed into a paste with oil; and exposed the whole to the heat of a forge raised to 166° Wedgwood. By this process he obtained a dark coloured agglutinated mass, having a brilliant appearance on the surface. Titanium obtained in this way, is of a reddish yellow colour, shining and brilliant on the surface, and equally brilliant in some of its internal cavities.

Titanium seems to be one of the most infusible metals known. When the red oxide is exposed to heat in a crucible, it loses its lustre. By the action of the blowpipe it is deprived of its transparence, and becomes of a greyish-white colour. On charcoal it becomes still more opaque, and of a slate-grey. The artificial carbonate of titanium, exposed to heat in a crucible, loses $\frac{25}{100}$ of its weight, becomes yellow, and as it cools resumes its white colour. Titanium enters into combination with phosphorus, and forms with it a phosphuret. This was prepared by M. Chenevix, by exposing a mixture of phosphate of titanium, charcoal, and a little borax, in a crucible, to a very strong heat. The phosphuret which he obtained was in the form of a metallic button, of a pale white colour, brittle, and granular, and infusible by the action of the blowpipe. This metal enters into combination with the acids, and forms salts with them.

If into a phial, filled with muriate of titanium, there is put a stick of tin, and the bottle enclosed with a stopper, a faint rose colour will soon be visible in that part of the solution adjacent to the tin, which by degrees will deepen to an amethystine red, and extend through the whole liquor. If zinc be substituted instead of tin, the solution will be first violet, and at length indigo blue. Attempts have been made to alloy titanium with other metals, but without success. The white oxide, and also titanite, in substance, are said to afford, when mixed with enamel flux, a straw yellow colour; and we are informed that it has been used in the porcelain manufactory at Sévres, as an ingredient in rich browns; but the difficulty of obtaining a regular and uniform tint, has at length occasioned it to be abandoned.

TITHES, are the tenth part of the increase, yearly, arising and renewing from the profits of lands, the stock upon lands, and the personal industry of the inhabitants. And hence they are usually divided into three kinds; praedial, mixed, and personal. Praedial tithes, are such as arise merely and immediately from the ground, as grain of all sorts, hay, wood, fruits, herbs. For a piece of land, or ground, being called in Latin *prædium*, whether it be arable, meadow, or pasture, the fruit or produce thereof is called prædial, and consequently the tithe payable for such annual produce is called a prædial tithe.

Mixed tithes, are those which arise not immediately from the ground, but from things immediately nourished from the ground; as by means of goods depastured thereupon, or otherwise nourished with the fruits thereof: as colts, calves, lambs, chickens, milk, cheese, eggs.

Personal tithes, are such as arise from the honest labour and industry of man, employing himself in some personal work, artifice, or negotiation; being the tenth part of the clear gain, after charges deducted.

Tithes, with respect to value, are divided into great and small: great tithes, as corn, hay, wood; small tithes, as the prædial tithes of other kinds, together with those that are mixed and personal.

Tithes of common right belong to that church, within the precincts of whose parish they arise. But one person may prescribe to have tithes within the parish of

another; and this is what is called a portion of tithes.

No tithe is due *de jure* of the produce of a mine, or of a quarry; because this is not a fruit of the earth, renewing annually; but is the substance of the earth, and has perhaps been so for a great number of years. But in some places tithes are due by custom, of the produce of mines.

No tithe is due of lime; the chalk of which this is made being part of the soil. Tithe is not due of bricks, which are made from the earth itself. Nor of turf, nor of gravel; because both these are part of the soil.

It has been held that no tithe is due of salt, because this does not renew annually. But every one of these, and all things of the like kind, may by custom become tithable.

If barren land is converted into tillage, no tithe shall be paid for the first seven years; but if it be not barren in its own nature, as if it be woodland grubbed and made fit for tillage, tithes shall be paid presently; for woodland is fertile, not barren.

Glebe lands, in the hands of the parson, shall not pay tithe to the vicar; nor being in the hands of the vicar, shall they pay tithe to the parson: because the church shall not pay tithes to the church. But if the parson let his rectory, reserving the glebe lands, he shall pay the tithes thereof to the lessee.

No tithes are due for houses; for tithes are only due of such things as renew from year to year. But houses in London are, by decree, which was confirmed by an act of parliament, made liable to the payment of tithes. There is likewise, in most ancient cities and boroughs, a custom to pay tithes for houses; without which there would be no maintenance in many parishes for the clergy.

As to mills, it is now settled by a decree of the House of Lords, upon an appeal from a decree of the Court of Exchequer, that only personal tithes are due from the occupier of a corn mill. And the occupier of a new erected mill is liable to tithes, although such mill is erected upon land discharged of tithes. Cro. Jac. 429.

Agistment, or the feeding of cattle, is subject to tithe. In the strict sense of the word, it means the depasturing of a beast the property of a stranger; but this word is constantly used in the books for depasturing the beast of an occupier of land, as well as that of a stranger. An occupier of land is not liable to pay tithe for the pasture of horses, or other beasts, which are used in husbandry in the parish in which they are depastured; because the tithe of corn is by their labour increased. But if horses, or other beasts, are used in husbandry out of the parish in which they depastured, an agistment tithe is due for them. No tithe is due for the pasture of milch cattle which are milked in the parish in which they are depastured; because the tithe is paid of the milk of such cattle. Nor is tithe due for the pasture of a saddle-horse, which an occupier of land keeps for himself or servants to ride upon. Cro. Jac. 430. But an occupier of land is liable to an agistment tithe for all such cattle as he keeps for sale. Cro. Eliz. 446. Milk cattle which are reserved for calving, shall pay no tithe for their pasture whilst they are dry; but if they be afterwards sold, or milked in another parish, an agistment tithe is due for the time they were dry. No tithe is due from an occupier of land for the pasture of young cattle, reared to be used in husbandry, or for the pail. Cro. Eliz. 446. But if such young beasts be sold before they come to such perfection as to be fit for husbandry, or before they give milk, an agistment tithe must be paid for them.

If cattle which have neither been used in husbandry, nor for the pail, are, after having been kept some time, killed, to be spent in the family of the occupier of the land on which they are depastured, no tithe is due for their pasture. No tithe is due for the cattle, either of a stranger or an occupier, which are depastured in grounds that have in the same year paid tithe of hay. But it is generally true, that an agistment tithe is generally due for depasturing any sort of cattle, the property of a stranger. Cro. Eliz. 276.

No agistment tithe is due for such beasts, either of a stranger or an occupier, as are depastured on the head lands of ploughed fields: provided these are not wider than is sufficient to turn the plough and horses upon. Nor is tithe due for such cattle as are depastured upon land that has the same year paid tithe of corn.

If land which has paid tithe of corn one year, is left unsown the next year, no agistment is due for such land: because, by this lying fresh, the tithe of the next crop of corn is increased. But if land, which has paid tithe of corn in one year, is left unsown the next year, no agistment is due for such land; but if suffered to lie fallow longer than by the course of husbandry is usual, an agistment tithe is

due for the beasts depastured upon such land.

Sheep, after paying tithe of wool, had been fed upon turnips not severed, by which they were bettered to the value of five shillings each, and were then sold: it also appeared, that before the next shearing time, as many had been brought in as were sold, and that of these tithe of wool had been paid. It was insisted, that if an agistment were to be paid for the sheep sold, it would be a double tithing: but the court held that this was a new increase, and decreed the defendant to account for an agistment tithe. But in a latter case the court held, that no agistment tithe should be paid.

Corn. It is held, that no tithe is due of the rakings of corn involuntarily scattered. Cro. Eliz. 278. But if more of any sort of corn be fraudulently scattered than there would have been if proper care bad been taken, tithe is due of the rakings of such corn. Cro. Eliz. 475. No tithes are due of the stubbles left in corn fields after mowing or reaping of corn.

Tithe of hay is to be paid, though beasts of the plough, or pail, or sheep, are to be foddered with such hay. But no tithe is due of hay upon the head lands of ploughed grounds, provided that such head lands are not wider than is sufficient to turn the plough and horses upon.

It is laid down in an old case, that if a man cut down grass, and, while it is in the swathes, carry it away, and give it to his plough-cattle, not having sufficient sustenance for them otherwise, no tithe is due thereof. And in a modern case, the Court of Exchequer was of opinion, that no tithe is due of vetches, or of clover, cut green, and given to cattle in husbandry.

Tithe of wood is not due in common right, because wood does not renew annually; but it was in ancient times paid in many places by custom. Exemptions from tithes are of two kinds: either to be wholly exempted from paying any tithes, or from paying tithes in kind. The former is called *de non decimando*; the latter *de modo decimandi.*

Prescription *de non decimando* is to be free from the payment of tithes, without any recompense for the same. Concerning which the general rule is, that no layman can prescribe *de non decimando*, that is, to be discharged absolutely of the payment of tithes, and to pay nothing in lieu thereof; unless he begin his prescription in a religious or ecclesiastical person. But all spiritual persons, as bishops, deans prebendaries, parsons, and vicars, may prescribe generally *in non decimando.*

A *modus decimandi*, usually called by the name of *modus* only, is where there is by custom a particular manner of tithing, different from the general laws of taking tithes in kind. This is sometimes a pecuniary compensation, as so much an acre for the tithe of land; sometimes a compensation in work and labour; as that the parson shall have only the twelfth cock of hay, and not the tenth, in consideration of the owner's making it for him; sometimes in lieu of a large quantity, when arrived to great maturity; as a couple of fowls in lieu of tithe-eggs, and the like. Any means, in short, whereby the general law of tithing is altered, and a new method of taking them is introduced, is called *modus decimandi*, or special method of tithing.

In order to make a *modus* or prescription good, several qualifications are requisite. It must be supposed to have had a reasonable commencement, as that at the time of the composition, the *modus* was the real value in money, although it is now become much less. It must be something for the parson's benefit; therefore, the finding straw for the body of the church, the finding a rope for a bell, the paying five shillings to the parish-clerk, have been adjudged not to be good. But it is a good *modus* to be discharged, that one hath time out of mind been used to employ the profits for the repair of the chancel, for the parson hath a benefit by that.

A *modus* must be certain; so a prescription to pay a penny, or thereabouts, for every acre of land, is void for the uncertainty. And it has been held, that if a precise day of payment be not alleged, the *modus* will be ill; but now it is holden, that where an annual *modus* hath been paid, and no certain day for the payment thereof is limited, the same shall be due and payable on the last day of the year.

A *modus* must be ancient; and therefore, if it be any thing near the value of the tithe, it will be supposed to be of late commencement, and for that reason will be set aside.

A *modus* must be durable; for the tithe in kind, being an inheritance certain, the recompense for it should be as durable; therefore a certain sum, to be paid by the inhabitants of such an house, hath been set aside, because the house may go down, and none inhabit it. And it must be constant and uninterrupted; for if there have been frequent interruptions, no custom

or prescription can be obtained. But after it hath been once duly obtained, a disturbance for ten or twenty years shall not destroy it.

When a common is divided and inclosed, a *modus* shall only extend to such tithes as the common yielded before inclosure, such as the tithes of wool, lambs, or agistment: but not to the tithes of hay and corn, which the common, whilst it was common, did never produce.

The parson cannot come himself and set out his tithes without the consent of the owner; but he may attend and see them set out; yet the owner is not obliged to give him notice when he intends to set it out, unless it be by special custom. After it is set out, the care thereof, as to wasting or spoiling, rests upon the parson, and not upon the owner of the land; but the parson may spread, dry, and prepare his corn, hay, or the like, in any convenient place upon the ground, till it be sufficiently weathered, and fit to be carried into the barn. And he may carry his tithes from the ground either by the common way, or such other way as the owner of the land uses to carry away his nine parts. If the parson suffer his tithes to stay too long upon the land, the other may distrain the same as doing damage; or he may have an action on the case: but he cannot put in his cattle and destroy the corn, or other tithe; for that would be to make himself judge what shall be deemed a convenient time for taking it away.

By 1 Geo. I. c. 6. all customary payments due to clergymen, the payment of tithes, &c. is enforced; and the prosecution in this case may be, for any tithes or church-rates, or any customary or other rights, dues, or payments, belonging to any church or chapel, which of right, by law, and custom, ought to be paid for the stipend or maintenance of any minister or curate, officiating in any church or chapel, provided that the same do not exceed twenty pounds.

But the time is not limited within which the same shall become due, and if any quaker shall refuse to pay or compound for the same, any parson, vicar, curate, farmer, or proprietor of such tithes, or any church-warden, chapel-warden, or other person, who ought to have, receive, or collect, any such tithes, rates, dues, or payments, may make complaint to any two justices, other than such as is patron of the church, or chapel, or interested in the tithes.

The number of days is not limited between the time of refusal, and the complaint, nor is it hereby required that such complaint shall be in writing. But it will be more conformable to the usual practice in like cases, if it be in writing. Upon which complaint, the said justices are required to summon in writing, under their hands and seals, by reasonable warning, such quaker, against whom such complaint shall be made. And after appearance, or on default of appearance, (the warning, or summons, being proved before them upon oath,) they may proceed to examine on oath the truth of the complaint, and to ascertain and state what is due and payable.

And by order under their hands and seals, they may direct and appoint the payment thereof, so as the sum ordered as aforesaid do not exceed ten pounds. And also such costs and charges, as upon the merits of the cause, shall appear not exceeding ten pounds. And on refusal to pay, any one of the two next justices, by warrant under his hand and seal, may levy the same by distress and sale, rendering the overplus, the necessary charges of distraining being first deducted and allowed by the said justice; unless it be in the case of appeal, and then no warrant of distress shall be granted, till the appeal shall be determined.

As no time is limited for detaining the distress, nor charges allowed for keeping it, it may be sold immediately. Any person, who shall think himself aggrieved by the judgment of the two justices, may appeal to the next sessions; where, if the judgment shall be affirmed, they shall decree the same by order of sessions, and give costs against the appellant, to be levied by distress and sale, as to them shall seem reasonable. And no proceeding herein shall be removed by certiorari, or otherwise, unless the title of such tithes shall be in question.

The withholding of tithes from the parson or vicar, whether the former be a clergyman or lay-appropriator, is among the pecuniary causes cognizable in the ecclesiastical court. But herein a distinction must be taken; for the ecclesiastical courts have no jurisdiction to try the right of tithes, unless between spiritual persons, between spiritual men and laymen, and are only to compel the payment of them, when the right is not disputed.

TOAD, in zoology, belongs to the same genus with the common frog. See RANA.

TOBACCO, in botany. See NICOTIANA.

After sowing tobacco seeds, the ground is watered every day, and in hot weather covered, to prevent its being scorched by the sun; and when the plants are grown

to a convenient pitch, they are transplanted into a soil well prepared for their reception: care is also taken to keep this ground clear of weeds, and to pull off the lowest leaves of the plant, that ten or fifteen of the finest leaves may have all the nourishment. When these leaves are ripe, which is known by their breaking when bent, the stalks are cut, and left to dry two or three hours in the sun; after which they are tied together two and two, and hung on ropes under a shade to be dried in the air. And when the leaves are sufficiently dried, they are pulled from off the stalks, and made up in little bundles; which, being steeped in sea water, or, for want thereof, in common water, are twisted in manner of ropes, and the twists formed into rolls, by winding them with a kind of mill around a stick: in which condition it is imported into Europe, where it is cut by the tobacconists for smoking, formed into snuff, and the like. Besides the tobacco of the West Indies, there are considerable quantities cultivated in the Levant, the coasts of Greece and the Archipelago, the island of Malta and Italy.

TODUS, the *tody*, in natural history, a genus of birds of the order Picæ. Generic character: bill thin, depressed, broad, and at the base covered with bristles; nostrils small and oval; toes three before and one behind, the middle much connected with the outer. There are sixteen species, of which the following is the pincipal:

T. viridis, or the green tody, is of the size of a wren, and is found in the warm climates of America, and in the West Indies. Its colouring is a beautiful combination of green, white, and red. It is solitary, stupid, feeds upon soft insects, frequents moist situations, sitting long together with its head under its shoulder, and may sometimes be taken by the hand. Birds of this genus are principally found in the warmer territories of America, are somewhat allied to the genus of Flycatchers, but are distinguished by a considerable connection between the toes, whereas those of the flycatcher are completely divided. Several species are much larger than the above.

TOISE is a French measure, containing six feet, or a fathom; a square toise is thirty-six square feet. The toise and the fathom correspond in the division of the feet; but these divisions being unequal, it is necessary to observe that the proportion of the yard, as fixed by the Royal Society at London, to the half toise as fixed by the Royal Academy at Paris, is as 36 : 33.355.

TOLUIFERA, in botany, *balsam of Tolu tree*, a genus of the Decandria Monogynia class and order. Natural order of Terebintaceæ, Jussieu. Essential character: calyx five-toothed, bell-shaped; petals five, the lowest twice as big, obcordate: style none. There is but one species, *viz.* T. balsamum, balsam of solu tree. It is a native of Spanish America, in the province of Tolu, near Carthagena; it is a tree of a considerable size, the bark is thick, rough, and of a brown colour, the branches spread wide on every side; leaves alternate, oblong, four inches long, and two broad in the middle, rounded at the base, acuminate at the end, smooth, of a light green colour, on very short foot stalks; the flowers are produced in small axillary racemes, or bunches, each on a slender pedicle; the corolla has four narrow petals of a yellow colour, a little longer than the calyx, and a fifth, the claw of which is of the same length as the other petals, and the top ovate cordate; stamens within the tube, and terminated by oblong erect sulphur-coloured anthers; fruit roundish, the size of a large pea, divided into four cells, each containing one oblong ovate seed. The balsam of Tolu, which is brought to Europe in little gourd shells, is obtained by making incisions in the bark of the tree; it is collected in spoons, which are made of black wax, and from them it is poured into proper vessels; it is of a reddish yellow colour, transparent, in consistence thick, and tenacious; by age it grows hard and brittle, so that it may be rubbed into a powder between the finger and thumb; its smell is extremely fragrant; its taste is warm and sweetish; thrown into the fire it immediately liquifies, takes flame, and disperses its agreeable odour.

TOMENTUM, in botany, *short wool*, a species of hoary or downy pubescence, which covers the surface of many plants, particularly those in the neighbourhood of the sea, and such as in their native soil are exposed to the ravages of bleak and violent winds. The substance in question consists of a number of small hairs, that are so closely interwoven as scarcely to be distinguished by the naked eye, the white appearance arising from their aggregation and compact texture.

TOMEX, in botany, a genus of the Dodecandria Monogynia class and order. Essential character: involucre four or five-leaved; calyx none; corolla five-pe-

talled; nectary scales five, between the lower stamens; berry one-seeded. There are three species, among which we shall notice the T. sebifera, glutinous tomex, or tallow-tree; it grows to a considerable size, with spreading branches; leaves ovate, oblong, quite entire, smooth, alternate, petioled; peduncles lateral, and subterminating, two or three-flowered; berries small, smooth, and blackish. Native of China and Cochin-China. The wood, which is light, and of a pale colour, is used for rafters, studs, &c. in building; the leaves and twigs abound in a viscid juice, and being bruised and macerated in water, render it glutinous; for this reason the natives work up their plaster with it, to render it more tenacious, and also that it may last the longer; a great quantity of a thick white oil is extracted from the berries, of which common candles are made, resembling spermaceti or wax candles, but having an unpleasant smell.

TOMPION, in naval affairs, a circular piece of wood used to stop the mouth of a cannon. At sea, the tompions are carefully encircled with tallow or putty, to prevent the penetration of the water into the bore, whereby the powder contained in the chamber might be rendered unfit for service.

TONNAGE, in military and naval affairs, a custom or impost due for merchandize, brought or carried in tons, from or to other nations, after a certain rate, in every ton. The method of finding the tonnage of any ship is by the following rule: Multiply the length of the keel by the breadth of the beam, and that product by half the breadth of the beam, and divide the last product by 94, and the quotient will be the tonnage. *Ex.* Suppose the ship's keel 72 feet, breadth of the beam 24 feet, then $\frac{72 \times 24 \times 12}{94} = 220.6$. The tonnage of goods is sometimes taken by weight, and sometimes by measurement. The method which yields the most is allowed to a vessel. In weight twenty hundred make one ton, but by measurement forty cubic feet are equal to one ton.

TONSELLA, in botany, a genus of the Triandria Monogynia class and order. Essential character: calyx five-parted; petals five; nectary pitcher-shaped; berry one-celled, four-seeded. There are two species, *viz.* T. scandens, climbing tonsella; and T. Africana, African tonsella, both natives of Guinea.

TONSILS, in anatomy, two remarkable glands, situated one on each side of the mouth, near the uvula, and commonly called almonds of the ears, from their resembling almonds in figure. Their use is to secrete a mucous humour for lubricating the passages: this they discharge by several irregular but conspicuous foraminæ into the mouth. See ANATOMY.

TONTINE, a variable kind of life annuity, but generally so contrived as to be progressively increasing in amount. It is formed by nominating a certain number of lives within limited ages, who, for each one hundred pounds, or any other gross sum paid down, are to receive at first a specific annuity; but as any of the lives fail, their annuity is to be equally divided among those that remain; by which means those who happen to survive a considerable number of years, obtain a large augmentation of their annual receipt; and the life, which is the longest liver of the whole (if there is no restriction to the contrary) gets for the remainder of its continuance, the total sum paid at first to all the nominees. Tontines of this kind, if properly conducted, are considered by some persons as affording an eligible opportunity of making some provision for children, as the nomination of young healthy lives gives a good chance of survivorship. It has several times been attempted to raise money on this species of annuity for the service of government, but it has never been found practicable to obtain any considerable sum in this way: on a smaller scale, it has been adopted successfully both in Great Britain and Ireland, for procuring the sums necessary for building bridges, large inns or hotels, and other expensive edifices.

Of late years many delusive schemes have been set on foot under the name of tontines, but differing very materially from the plan above mentioned, as they do not require a gross sum to be paid down, but quarterly or half yearly payments during their continuance, which is limited to the short period of five, seven, or ten years; the intention being, that the subscribers should receive back all they had contributed, with the additions made to it from improvement at compound interest, and the division of the contributions of such as might happen to die within the term. But the difference between compound and simple interest in the improvement of such payments, for a short time, is so trifling, and the

probability of any considerable reduction, during such term, in the number of a set of young lives, who it may be presumed were thought healthy subjects at the time of their nomination, is so small, that the advantages derived from these sources have been sometimes overbalanced by the expenses of management, and, in fact, in several instances of these schemes, which have expired within these few years past, the subscribers have actually received considerably less than the payments they had made would have amounted to without any improvement at interest.

TOP, in naval affairs, a sort of platform surrounding the lower mast head, from which it projects on all sides like a scaffold. The intention of the top is to extend the top-mast shrouds so as to form a greater angle with the mast, and thereby give additional support to the latter. The top is likewise convenient to contain the materials necessary for extending the small sails, and for fixing and repairing the rigging and machinery with greater expedition. In ships of war, the tops are furnished with swivels, musketry, and other fire-arms, and are guarded with a fence of hammocks in time of action. In this case the top is used as a kind of redoubt; and is accordingly fortified for attack or defence, being furnished with arms, and guarded by a thick fence of corded hammocks. The top is employed likewise as a place for looking-out, either in the day or night.

TOPAZ, in mineralogy, is a species of the flint genus, of a wine-yellow colour, of all degrees of intensity, and passing to various other colours. It occurs massive, disseminated, sometimes in rolled pieces, but commonly crystallized. There are many varieties. Specific gravity, according to Werner, is about 3.5. The Saxon variety, in a gentle heat, turns white; but a strong heat deprives it of lustre and transparency: the Brazilian, by exposure to a high temperature, burns rose-red; and in a still higher, violet-blue. Before the plow-pipe, it is scarcely fusible; but exposed to a stream of oxygen gas, it melts into a porcellanous bead. It is fusible with borax, but alkali has little effect on it. The Brazilian, Siberian, and other topazes, when heated, exhibit at one extremity positive, and at the other negative, electricity. The Saxon topaz, by friction only, gives signs of electricity. The constituent parts are, according to Vauquelin,

Silica	31
Alumina	68
Loss	1
	100

It is found in veins that traverse primitive rocks, accompanied by fluor-spar, tin ore, and arsenical pyrites. It is found in Brazil; in Siberia, among the Uralian mountains. The topaz of the ancients is supposed to be our chrysalite. The Saxon topaz is most valued by jewellers, though even this is in no very high estimation.

TOPIC, in rhetoric, denotes a probable argument, drawn from the several circumstances of a fact, &c. Hence the art of finding and managing such arguments is called by the ancients topica.

TOPOGRAPHY. This term is applied to all those writings which have for their subjects the description of tracts of country, and the buildings on their surfaces. We often meet with passages in the works of ancient authors which are topographical, or in other words, descriptive of particular places; but rarely or never with volumes dedicated wholly to this purpose. The scriptures have many of the former, particularly the account of Solomon's temple: Homer abounds with such in his Iliad and Odyssey; and Virgil in his Æneid; to which might be added subsequent writers, though not of equal celebrity. The two Plinys have favoured us with sketches of this nature, one of which, by the younger, we shall introduce as a specimen. Speaking of his Tuscan villa, he says, "The face of the country is extremely beautiful. Imagine to yourself an amphitheatre of immense circumference, such as could be formed only by the hand of nature: a wide-extended plain is surrounded by mountains, whose summits are covered with tall, ancient woods, stocked with game for all kind of hunting; the descent is planted with under-woods, among which are frequently little risings, of a rich and deep soil, where a stone, if sought for, is scarce to be found: in fertility they yield not to the finest vales, and produce as good crops of corn, although not so early in the year. Below these, on the side of the mountain, is a continued range of vineyards, that extend themselves without interruption far and near, at the foot of which is a sort of border of shrubs. From thence you have meadows and open fields: the arable grounds require large,

oxen and the strongest ploughs; the earth is so tough, and rises in such large clods when it is first broken up, that it cannot be reduced till it has been ploughed nine times: the meadows glitter with flowers, and produce the trefoil and other kinds of grass, always soft and tender, and appearing always new; for they are excellently well watered with never-failing springs; yet where these springs are in greatest confluence, they make no marshes, the declivity of the land discharging into the Tiber all the water that it does not drink in."

Had it been the custom at those very distant periods of time to write thus, frequently, and had the art of printing been then invented, how much valuable information would have reached us that is now irretrievably lost; and with what pleasure should we have read descriptions of many important places, the scites of which are now only known by conjecture from some casual circumstance! Numbers of beautiful cities, far surpassing any existing at present in the magnificence of their public structures, have been deserted, through different causes, by their inhabitants, and are yet splendid in their ruins: those offered every incitement for description, but have perished without obtaining this act of justice. Egypt, in particular, furnished the writer with the means of immortalizing his name as a topographer; and it is a subject of severe regret, that we have not been gratified by an account of that country, when all the wonderful fragments scattered over its surface were connected by the chain of society, and perfect in themselves; then, we have every reason to suppose, rich woods fringed the borders of their cities, and extensive gardens afforded equal pleasure and advantage to the inhabitants: like a sublime picture, we should have been enabled to contrast its ancient softest tints with its present dreary wastes and gloomy ruins.

The French have ever been an enterprizing people, and very early turned their attention to travelling, and topographical description; an interesting account of which may be found in Mr. Johnes's recent translation of "Bertrand de la Broquiere's Travels in Palestine," about the year 1432. The English nation did not entirely neglect this species of literature, in the earliest periods of their annals; as several monks might be mentioned, who gave their brethren, in different parts of the country, manuscript accounts of the foundations of their monasteries, and some slight description of them and their scites. We shall introduce the title of one of those, quoted by Mr. Malcolm, in his "History of St. Bartholomew's Priory, London," in order to convey to the reader an idea of their abilities in our language, about the time of Henry III. or perhaps rather earlier: "For, as mooche that the meritory and notable operacyons of famose goode and devoute faders yn God sholde be remembred, for instruction of aftercūmers to theyr consolacion and encres of devotion; thys abbrevyat tretesse shal compendiously expresse and declare the wondreful, and, of celestial concel, gracious foundacion of our hoely placeys, called the priory of Seynt Bartholomew yn Smythfyld, and of the hospital of olde tyme longyng to the same; with other notabilities expediently to be knowyn; and most specially the gloriouse and excellent myracles wroghte withyn them by the intercessions, suffrages, and merytys of the forsayd benynge, feythful, and blessid of God, apostyl Sanct Bartholomy, ynto the laude of Almighty God, and agmcion of his infinite power. Ffyrst shal be shewyd who was ffunder of owere hoely places, and howgh, by grace, he was ffyrst pryor of owr priory; and by howgh longe tyme that he contynued yn the same Thys churche, yn the honoure of most blessed Bartholomew apostle, ffunded Rayer, of good remembraunce. And theryn to serve God (after the rewle of the most holy fader Austyn) aggregat togidir religiouse men. And to them was prelate xxii yere; usynge the office and dignite of a priore." This ancient topographer mentions that Rahere, the prior and founder of the priory, died in the reign of king Stephen, and was succeeded by Thomas, in the year 1144. The following passage will prove that the manuscript was written immediately after the above period: "And yn what ordur he sette the fundament of this temple yn fewe wordes lette us shewe, as they testified to us *that sey him, herd him*, and were presente yn his workys and dedis; *of the whiche* sume have take ther slepe yn Cryiste, and *sume of them be zitte alyve*, and wytnesseth of that that we shall after say."

It may be perceived from this specimen of early topography, that we had by no means arrived to the degree of excellence which Pliny and his contemporaries attained in similar productions; neither did we accomplish this very desirable point till within the last century. Those who have perused our best works, his-

torical and descriptive, before the reign of George II. will find great accuracy and deep research; but unfortunately we learn nothing of the nature and beauties of the surface of the earth, or of the proportions and sculptures of our buildings, from the valuable works of Leland, Stowe, Speed, Camden, Dugdale, &c. indeed had not Hollar been employed by the latter, his splendid accounts of monasteries, and St. Paul's, would have given us no idea whatever of the richness of their forms and decorations.

It is, however, to the authors, whose names we have recapitulated, that we are indebted for admirable models in topography; and it would be injustice to the moderns to deny them the merit of having greatly improved upon them, by their descending to the minutiæ which seems to have escaped the attention of their great predecessors. The public has for a very considerable length of time been extremely partial to topographical works, which is evinced by the shoals of publications issued from the London and provincial presses on this subject. The metropolis has had every thing said of it which the art of man could rake together; almost every county has its historian, and some have had several; the cities have each been described, and every town, worth or not worth a description, has its guide; and, exclusive of those, numbers of tours are continually making their appearance. It appears almost invidious to mention any particular exertions, without enumerating every well-founded pretension to public approbation; and yet we cannot conclude this article accurately without observing, that Gough's edition of Camden's "Britannia," and his "Sepulchral Monuments" of this kingdom, are worthy of ranking with the works of our best ancient topographers; and that amongst the many excellent county histories we possess, none has a greater claim for extent and accuracy than the "History of Leicestershire," by Mr. John Nichols. The environs of London have received every possible attention from the indefatigable brothers, Daniel and Samuel Lysons, who are now pursuing a most laborious undertaking on nearly the same plan, to be extended to all England; and of London, the great centre, every thing has been said by Stowe, Strype, and Malcolm; besides the slighter performance of Pennant, to whom we are more indebted for his other topographical works; and, to conclude, we now possess a Topographical Dictionary, the patient and useful production of Mr. Carlisle.

The encouragement all these and similar publications have hitherto uniformly met with has been eminently advantageous to draftsmen and engravers, whose works, for the embellishment of topographical writings, are not surpassed by any which have made their appearance on the Continent, an assertion that may be proved decidedly by referring to the recent publications—"The Beauties of England and Wales," and "The Architectural Antiquities of Great Britain;" two of the best, without exception, that have ever issued from the British press; the joint performance, in the first instance, of Messrs. Britton and Brayley: and in the second, of the former only.

TORDYLIUM, in botany, *heart-wort*, a genus of the Pentandria Digynia class and order. Natural order of Umbellatæ, or Umbelliferæ. Essential character: corolla radiate; all hermaphrodite; fruit suborbicular, notched at the edge; involucres long, undivided. There are seven species.

TORENIA, in botany, so named from Olof Toreen, a Swedish clergyman, a genus of the Didynamia Angiospermia class and order. Natural order of Personatæ. Scrophulariæ, Jussieu. Essential character: calyx two-lipped, upper lip three cusped; filaments, the lower with a sterile branchlet; capsule two-celled. There are three species.

TORMENTILLA, in botany, a genus of the Icosandria Polygynia class and order. Natural order of Senticosæ. Rosaceæ, Jussieu. Essential character: calyx eight-cleft, inferior; petals four; seeds roundish, naked, wrinkled, fastened to a small, juiceless receptacle. There are two species: *viz.* T. erecta, common tormentil; and T. reptans, trailing tormentil. Natives of Europe.

TORNADO, a sudden and vehement gust of wind from all points of the compass, frequent on the coast of Guinea.

A tornado seems to partake much of the nature of a whirlwind, or perhaps of a water-spout, but is more violent in its effects. It commences very suddenly, several clouds being previously drawn together, when a spout of wind proceeding from them, strikes the ground, in a round spot of a few rods or perches diameter, and proceeds thus half a mile or a mile. The proneness of its descent makes it rebound from the earth, throwing such things as are moveable before it, but some sideways or in a lateral direction from it.

A vapour, mist, or rain, descends with it, by which the path of it is marked with wet. The following is a description of one which happened a few years since at Leicester, about fifty miles from Boston, in New England: it happened in July, on a hot day, about four o'clock in the afternoon. A few clouds having gathered westward, and coming overhead, a sudden motion of their running together in a point being observed, immediately a spout of wind struck the ground at the west end of a house, and instantly carried it away, with a negro man in it, who was afterwards found dead in the path of it. Two men and a woman, by the breach of the floor, fell into the cellar; and one man was driven forcibly up into the chimney corner. These were preserved, though much bruised; they were wet with a vapour or mist, as were the remains of the floor, and the whole path of the spout. This wind raised boards, timbers, &c. A joist was found on one end, driven nearly three feet into the ground. The spout probably took it in its elevated state, and drove it forcibly down. The tornado moved with the celerity of a middling wind, and constantly declined in strength till it entirely ceased.

TORPEDO. See RAIA.

TORRENT, in geography, denotes a temporary stream of water, falling suddenly from mountains, whereon there have been great rains, or an extraordinary thaw of snow.

TORRICELLI (EVANGELISTE,) in biography, an illustrious mathematician and philosopher of Italy, was born in 1608, and trained up in the knowledge of classical literature. The bent of his mind, however, led him to the pursuits of natural philosophy, which he studied under father Benedict Castelli, who had been the scholar of the great Galileo, and was professor of mathematics at Rome. Torricelli made such progress under this master, that having read Galileo's "Dialogues," he composed a "Treatise concerning Motion" upon his principles. Castelli, surprised at the performance, carried it and read it to Galileo, who heard it with great pleasure, and conceived a high ésteem and friendship for the author. Upon this, Castelli proposed to Galileo, that Torricelli should come and live with him; recommending him as the most proper person he could have, since he was the most capable of comprehending those sublime speculations, which his own great age, infirmities, and want of sight, prevented him from giving to the world. Galileo accepted the proposal, and Torricelli the employment, as things of all others the most advantageous to both. Galileo was at Florence, at which place Torricelli arrived in 1641, and began to take down what Gallileo dictated, to regulate his papers, and to act in every respect according to his directions. But he did not long enjoy the advantages of this situation, as Galileo died at the end of only three months. Torricelli was then about returning to Rome; but the Grand Duke engaged him to continue at Florence, making him his own mathematician for the present, and promising him the professor's chair as soon as it should be vacant. Here he applied himself intensely to the study of mathematics, physics, and astronomy, making many improvements, and some discoveries. Among others, he greatly improved the art of making microscopes and telescopes; and it is generally acknowledged that he first found out the method of ascertaining the weight of the atmosphere by a proportionate column of quicksilver, the barometer being called from him the Torricellian tube, and Torricellian experiment. Great things were now expected from him, and great things would probably have been further performed by him, if he had lived; but he died after a few days illness, in 1647, when he was but just entered the 40th year of his age. His principal work was entitled "Opera Geometrica," in 4to.

TORRICELLIAN *experiment*, a famous experiment made by Torricelli, a disciple of the great Galileo, which has been already explained under the article BAROMETER. See also PNEUMATICS.

TORRID *zone*, among geographers, denotes that tract of the earth lying upon the equator, and on each side as far as the two tropics, or 23° 30′ of north and south latitude. The torrid zone was believed by the ancients to be uninhabitable; but is now well known to be not only inhabited by the natives of those hot climates, but even tolerable to the people of the colder climates, towards the north and south; the excessive heat of the day being there tempered by the coldness of the night. See the article HEAT.

TOUCH, or FEELING, *sense of.* When the mind has connected the complex ideas derived from the touch with the visible appearance of objects, then the sight is indefinitely the most useful medium of knowledge: but in the earliest stages of the intellectual progress, the touch is the most useful; in fact, as man is formed, it then is absolutely necessary to render the

sight productive of most of its present utility. The sense of feeling differs from the other senses in belonging to every part of the body, external or internal, to which nerves are distributed. The term touch is most correctly applied to the sensibility which is diffused over the surface of the body. Touch exists with the most exquisite degree of sensibility at the extremities of the fingers and thumbs, and in the lips. The sense of touch is thus very commodiously disposed for the purpose of encompassing smaller bodies, and for adapting itself to the inequalities of larger ones.

The sensations acquired by the sense of feeling are those of heat, hardness, solidity, roughness, dryness, motion, distance, figures, &c. and all those corporeal feelings which arise from a healthy or diseased state of the nerves, and the part of the body to which they belong.

The pains of this sense are more numerous and vivid than those derived from any other sense; and therefore the relicts of them, coalescing with one another, constitute the greatest share of our mental pains, that is, pains not immediately derived from sensation. On the other hand, its pleasures being faint and rare, in comparison with others, and particularly those of the taste, have but a small share in the formation of the mental pleasures.

The touch is the original medium of our knowledge respecting the real qualities of substances, and is indeed the sole medium by which we gain a knowledge of external objects. It is by the touch, and by the touch alone, originally, that we distinguish our own bodies from other objects that surround us, and form the impression which every one has, that the objects which affect the sight, the hearing, &c. are external. When we touch a sensible part of our bodies, we have sensations conveyed to the mind through two different nervous branches; when we touch any other body, we have only one sensation.

The impression that they are external objects, that is, objects out of ourselves, which give us the sensations of sound, taste, sight, and smell, is so continually forced upon us by the sensations of touch, that there probably never was found a person, who doubted the existence of the external world as the cause of his sensations, except those who have been led to it by reasoning on false principles. Some very acute speculators have indeed given up the belief in an external world as the cause of their sensations; but their opinion never did, nor never can, gain much ground; for it is inconsistent with the perceptions, which, by the constitution of our frame, are necessarily formed from continually recurring sensations. The philosophic Berkeley, and a late writer, Drummond, are the principal supporters of this curious system. But if we had not the sense of touch, the other senses would have produced no such impression; sensations would have appeared to arise in the mind without any connection with external causes of them.

Some philosophers have supposed, that it is the exquisite delicacy of feeling which exists in the hand, and the admirable mechanism by which it is applied, which is the cause of the superiority of knowledge which man possesses over the lower classes of animals. It cannot be just to attribute to this cause alone this superiority; but indisputably, as man is constituted, it is essential to the degree of superiority now possessed; and we observe, that that tribe of animals possesses the greatest degree of what may be called human wisdom, which has this sense most perfect; the bended muscle at the end of the elephant's trunk answering some of the purposes of the human fingers.

Touch *needle*, among assayers, refiners, &c. little bars of gold, silver, and copper, combined together in all the different proportions and degrees of mixture; the use of which is to discover the degree of purity of any piece of gold or silver, by comparing the mark it leaves on the touch-stone with those of the bars.

The metals usually tried by the touchstone are, gold, silver, and copper, either pure, or mixed with one another in different degrees and proportions, by fusion. In order to find out the purity or quantity of baser metal in these various admixtures, when they are to be examined, they are compared with these needles, which are mixed in a known proportion, and prepared for this use. The metals of these needles, both pure and mixed, are all made into laminæ or plates, one twelfth of an inch broad, and of a fourth part of their breadth in thickness, and an inch and a half long; these being thus prepared, you are to engrave on each a mark, indicating its purity, or the nature and quantity of the admixture in it.

TOURMALINE. See Schorl.

TOURN, the sheriff's tourn, is the king's court of record, holden before the

sheriff, for redressing of common grievances within the county. This is not now held.

TOURNEFORTIA, in botany, so named in memory of Joseph Pitton Tournefort, a genus of the Pentandria Monogynia class and order. Natural order of Asperifoliæ. Borragineæ, Jussieu. Essential character: berry two-celled, two-seeded, superior, perforated at top by two pores. There are eleven species; these shrubs are mostly natives of South America; several of them were first discovered by Father Plumier, who gave them the name of pittonia, which Linnæus changed to Tournefortia

TOURNEQUET, in surgery, an instrument made of rollers, compresses, screws, &c. for compressing any wounded part, so as to stop hæmorrhages.

TOURRETTIA, in botany, so named from Mons. de la Tourrette, a genus of the Didynamia Angiospermia class and order. Natural order of Personatæ. Bignoniæ, Jussieu. Essential character; calyx two-lipped; corolla, lower lip none, but two toothlets instead of it; capsule echinate, four celled, two valved. There is only one species, *viz.* T. lappacea, a native of Peru.

TOW *to*, in naval affairs, is to draw a ship, or boat, forward in the water, by means of a rope attached to another vessel or boat, which advances by the effort of rowing or sailing. Towing is either practised when a ship is disabled, and rendered incapable of carrying sail at sea; or when her sails are not fixed upon the masts, as in a harbour, or when they are deprived of their force of action by a cessation of the wind.

TOWER, a tall building consisting of several stories, usually of a round form, though sometimes square or polygonal. Towers are built for fortresses, prisons, &c. as the Tower of London, the Tower of the Bastile, &c. The Tower of London is not only a citadel to defend and command the city, river, &c. but also a royal palace, where our kings, with their courts, have sometimes lodged; a royal arsenal, wherein are arms and ammunition for sixty thousand soldiers; a treasury for the jewels and ornaments of the crown; a mint for coining of money; the great archive, wherein are preserved all the ancient records of the courts of Westminster, &c. and the chief prison for state criminals.

TOZZIA, in botany, so named in honour of Bruno Tozzia, Abbot of Vallumfrosa, F. R. S. a genus of the Didynamia Angiospermia class and order. Natural order of Personatæ. Lysimachiæ, Jussieu. Essential character: calyx five-toothed: capsule one-celled, globular, one-seeded. There is only one species, *viz.* T. alpina, a native of the mountains of Switzerland, Austria, South of France, Italy, and the Pyrenees.

TRACHELIUM, in botany, *throat-wort*, a genus of the Pentandria Monogynia class and order. Natural order of Campanaceæ. Campanulaceæ, Jussieu. Essential character: corolla funnel-form; stigma globular; capsule three-celled, inferior. There are three species, all found at the Cape of Good Hope.

TRACHICHTHYS, in natural history, a genus of fishes of the order Thoracici. Generic character: head rounded in front, eye large, mouth wide, toothless, descending; gill-membrane eight-rayed; the four lowest rays rough on the edges; scales rough; abdomen mailed with large carinated scales. The only species under this genus is T. australis, or the southern trachichthys, about five inches long and two deep, and a native of New-Holland. Its body is so strongly coated with scales, that they cannot be detached without part of the skin. Its eyes are extremely large, its tail is strongly forked, and its abdomen is carrinated, and cataphracted by a row of eight strong scales, each of which projects into a short spine pointing backward, and forming a sharp keel beneath. See Plate VI. Pisces. fig. 7.

TRACHINUS, in natural history, a genus of fishes of the order Jugulares. Generic character: head compressed, spinous at the top; gill-membrane six-rayed, the covers aculeated; lower lamina serrated. There are two species. T. draco, or the dragon-weaver, is usually about eleven inches long, and inhabits the North Seas and the Mediterranean, often imbedding itself in the sand on the coasts. It feeds on worms, insects, and small fishes, and is in great estimation in various countries of Europe for the table. It is remarkable principally for inflicting very painful wounds with its first dorsal fin, which is armed with five strong and sharp spines. The wounds thus given are attended with great heat and violent redness, and are not a little dreaded by the fishermen of France and Holland.

TRADE, the practice of exchanging goods, wares, money, bills, and other articles of value, with the view of advantage or profit. It is generally distinguished into foreign trade, or the export and

import of commodities to and from other countries, and the internal or home trade, or that which is carried on within the country; which two branches, however, are rather distinct in appearance than reality: one supports the other; and by their mutual connection and dependence, the foreign and the domestic trade of Great Britain have risen together to their present unparalleled height. See COMMERCE and MANUFACTURES.

By the law of England, trade is considered so much for the general benefit, that, by several statutes, particularly Magna Charta, 9 Henry III. c. 30, and 5 Richard II. c. 1, even all merchants, aliens, and not enemies, may safely come and go, and abide here, and deal, in gross or by retail, in any commodities; but, by statute 16 Richard II. c. 1, this was restrained, to prevent merchants, aliens, from selling any thing by retail, except victuals. And by several statutes, remedies are given for alien merchants against those by whom they may be disturbed in their dealings. But an alien cannot take a lease of a house, though he is a merchant; but may be a tenant at will. And no alien shall be a merchant or factor, unless naturalized, or made denizen, in the English plantations in Asia, Africa, or America. Some restraints are also put upon the importation of certain articles by statute 11 Edward III. c. 3; 3 Edward IV. c. 4; 19 Henry VII. c. 21; 25 Henry VIII. c. 9; and 5 Elizabeth c. 7.

The seas shall be open to all merchants; and all subjects may trade to Spain, France, and Portugal, paying the customs. In England all persons are free to use any trade, unless restrained by act of parliament, or the bye-laws of some corporations, or by the King's charter; for he may erect a corporation for the management of certain trades, and may even make a monopoly of some things, such as the sole printing of books of the common law, statute books, English bibles, prayer books, civil law books, and even school books, as it is said. But this prerogative is somewhat odious, and has not recently been enforced, excepting in respect to bibles, the statutes, and prayer books.

But the King cannot by his charter make a total restraint of trade. Even with respect to excluding the exercise of a trade in a town, or city, without being free of it, there is a great doubt whether a charter with such an exclusive privilege is valid, except as to London, where the bye-laws are confirmed by act of Parliament, although many such privileges are assumed elsewhere, and rest for their validity entirely upon ancient custom. The exclusive trade of the East India company is founded upon a charter, confirmed by act of parliament, 9 and 10 William III. c. 44, and subsequent statutes, and by 37 George III. c. 97, trade is allowed under the previous treaty with America, between that country and our settlements in the East Indies, either direct or way of Europe.

If a man contract, even for a good consideration, not to exercise a certain trade generally, such an agreement is void, as being in restraint of trade; but an agreement not to exercise a certain trade within a certain town, to the prejudice of another, is valid.

By the statute 5 Elizabeth, c. 4, none shall use any manual occupation then used in the realm, unless he has been brought up in it as an apprentice for seven years, under a penalty of 40*s*. per month. This statute has by some been considered as impolitic, and in general may be considered as a very slight restraint upon one who is successful in the trade. It has received a very liberal construction, so that, if a man has worked as a journeyman or master for seven years, he is considered to have served as an apprentice; and a person who is qualified, and directs the business, may have another in partnership who is not qualified. A trade is not transmissible, so as to go to executors; for if they carry it on, they must be personally liable.

The principal restraint upon trade which now exists is by the statutes respecting literary property (see that article), and the exclusive rights of inventors, under a patent for a limited time. These letters patent must be for the invention of new manufactures or machines, and are to be granted only for fourteen years from the date of the patent. Statute 21 James I. c. 3. In order to render such a patent valid, it must be under the great seal, and must be inrolled, and a specification of the particular process, or invention, must be inrolled in Chancery within six months. It is upon the novelty of the manufacture, as it respects England, and the fidelity of the specification, that the validity of the patent depends; for if a process is not fully and fairly described, or is described with any degree of fraud or concealment, the patentee cannot enforce the benefit of his invention, and the patent may be repealed upon application to the Chancellor by *scire facias*. Although an inven-

tion is not new abroad, yet if it has not been used here, a patent may be taken for it. See PATENT.

The aggregate gain which individuals engaged in foreign trade derive from it, can by no means be considered as shewing the accession of wealth which the nation receives from this source. Many circumstances may concur to diminish, or even wholly to destroy, the profit of foreign trade in this point of view, by which the gains of the merchant, and others, by whom it is carried on, are not in the least affected; thus, the payments made to other countries for the dividends on the share foreigners hold of our public debts; remittances of subsidies, or for the maintenance of troops; and the money spent abroad by British subjects occasionally resident there, all operate to the reduction of the actual wealth which this country would otherwise derive from its intercourse with other nations, which may therefore be very different from the general profit derived from trade, as a sum equal to the greater part, or even the whole, of the commercial gain may annually, or occasionally, be sent out of the country in the various ways just mentioned.

The balance of trade in favour of this country has usually been estimated from the excess of the exports beyond the imports, and a comparatively small amount of the latter has been always considered highly desirable. This is a concise mode of determining a very important point; but it is certainly very erroneous; for, in this view, the whole of the imports are considered as if they were paid for; whereas, in fact, a very large part of the imports never require to be paid for at all; and instead of tending to draw money out of the country, ought to be considered as an annual accession of wealth. This particularly refers to the imports from India, as far as they are purchased by the territorial revenues of that country, or by the private capitals of individuals acquired there; to such proportion of the imports from the West Indies as are remittances from the income of individuals residing here; and to the profits arising from fisheries carried on in different parts of the world by subjects of this country ordinarily residing here. Besides the evident impossibility of making this distinction in the account of imports, the custom-house statements, both of the imports and exports, are totally inadequate to show even their comparative amounts, as almost every article of merchandize is there rated at a value entirely different from its present actual value; but even if these accounts of the exports and imports were far better adapted to show on which side the balance really lies than they are, it will be easily proved that all the statements founded on them, in which the annual gain of the country from trade is exhibited by the excess of exports, must be inaccurate. Suppose the merchants of this country to purchase, for exportation, on their own account, British manufactures to the amount of 20,000,000*l.*; the net proceeds thereof in the countries to which they are exported, after paying all charges, cannot be considered as less than 22,000,000*l.*; and this sum being invested in foreign produce, and imported into this country, will amount, after repaying the duties and all expenses, to at least 24,200,000*l.* returning the merchants the capital they had originally advanced, with a profit of 21 per cent. Here is an evident gain to the country of 4,200,000*l.*, because the goods brought into it exceed in value those which were sent out by this sum. Will those who discover the commercial profits of the country in a small amount of imports, pretend that the advantage of the merchants, or of the state, would have been greater, if the imports received in return for the twenty millions sent out had been only of sixteen millions value?

If the merchandize imported in return for any quantity exported is of greater actual value in this country, that is, if it yields a greater price after allowing for all charges, and the interest of the capital employed, the surplus must be an addition to the wealth of the nation; and if the whole of our foreign trade was of this description, the excess of the imports would show the total profit, or the acquisition of wealth, by the exchange of commodities with other nations. It may, however, frequently happen, that a country carrying on a profitable commerce may not have occasion for an amount of equal or greater value than its exports in the produce or manufactures of other countries, in which case the imports from other countries will diminish, and the difference must be made up by coin or bullion, which, in a commercial view, ought to be considered nearly in the same light as any other articles of merchandize. In consequence of an act of Charles II. coin and bullion are exempt from entry at the custom-house on importation into this kingdom, therefore this

article cannot appear in the account of imports, though it is well known, that, besides the bullion used in keeping up or increasing the coin, and in importation and exportation as a merchandize, great quantities are imported as a raw material for the use of our manufactures. The quantity sent out of the country legally is known; the quantity imported must be much greater; but while no account of it is taken, the real amount of the imports must be very incomplete, and consequently any conclusions respecting the balance of trade, drawn from such a defective account, may be very erroneous. It cannot be denied, that, if the country derive a profit from its foreign trade, the value of the merchandize, and of the coin and bullion imported, must together exceed that of its exports; particularly as it has been shown, that a part of the former is to be considered rather as a remittance of property from abroad to its owners in this country than as a return for exports; it might indeed be otherwise for a short period, from our merchants allowing a longer or larger credit to their foreign correspondents; but this would be only a temporary suspension of the returns.

Therefore, as it appears by the Custom-house accounts, that the value of foreign produce and manufactures imported is usually considerably less than that of the exports, it would follow, supposing these valuations were correct, that the difference, together with a sum equal to the whole profits of foreign trade, is annually imported in cash and bullion, which are not included in those accounts. But if this were really the case, our stock of the precious metals, either in the form of bullion, specie, or goods manufactured of gold and silver, must have increased, not only to an amount greater than there is any evidence to prove, but far beyond all probability. In fact, this rapid flow of wealth into the country from foreign trade, which, although certainly great, is probably less than it would appear in the usual way of estimating it, has been almost constantly counteracted in various degrees, by political engagements with other countries, by losses at sea, and many other circumstances, by which wealth is carried out of the country without any advantageous return.

Trade *winds* denote certain regular winds at sea, blowing either constantly the same way, or alternately this way and that; thus called from their use in navigation, and the Indian commerce.

The trade-winds are of different kinds, some blowing three or six months of the year one way, and then the like space of time the opposite way; these are very common in the Indian seas, and are called monsoons.

Others blow constantly the same way; such is that general wind between the tropics, which, off at sea, is found to blow all day long from east to west.

TRADESCANTIA, in botany, *spider-wort*, a genus of the Hexandria Monogynia class and order. Natural order of Ensatæ. Junci, Jussieu. Essential character: calyx three-leaved; petals three; filaments equal, with jointed hairs; capsule three-celled. There are nineteen species.

TRAGACANTH. See Gum.

TRAGEDY, a drama which represents some grand and serious action, and which has frequently a fatal issue or end. Its genuine object is to purify and moderate the passions, by exhibiting them in their excess, and to hold forth such a picture of the crimes and miseries of mankind as may teach us, by fear, to be prudent, for our own sake; and, by compassion, to be charitable, for the sake of others. To produce this effect, three principles are essential to tragedy: first, it should represent our fellow-creatures in peril and misfortune; secondly, the peril should inspire us with alarm and dread, and the misfortune should interest and affect us; and, thirdly, the imitation should be conformable to nature and truth; that, while it engages our attention, it may render even the emotions of sorrow pleasing to us. On these principles are founded all the rules which relate to the choice of a subject, to the delineation of characters, and to the composition of the fable, dialogue, and action.

All events and circumstances which seriously influence mankind, and excite the stronger passions, are fit subjects for tragedy. Such, in the language of our great poet, are

"——The whips and scorns o' th' time;
Th' oppressor's wrong, the proud man's contumely,
The pangs of despis'd love, the law's delay,
The insolence of office, and the spurns
That patient merit of th' unworthy takes."

To these ills men in all conditions are liable, but it is seldom that the poet confines himself to a representation of them in common life, because the vicissitudes

incident to greatness afford him wider scope to display them. Hence tragedy, as was before observed, is frequently the imitation of a grand action, involving some important state concern, the fall of a chief, or the acquisition of a crown. Such events naturally rouse the passions of ambition, love, hatred, and revenge; and are calculated more deeply to affect the heart with sentiments of terror and pity. But whatever be the subject, the actual representation of tragic scenes ought never to be carried to excess. Murder and suicide should be banished from the stage, or admitted only in extreme cases, because the terror and the pity which such sights inspire are mingled with a feeling of horror, at which human nature revolts.

Of the rules for the composition of tragedy, the most important are those of the unities. (See Drama.) By the unities of time and place, it is meant, that the story should comprehend no longer a period of time than the representation, or, at most, that it should not exceed four and twenty hours; and that the place of action should never be supposed to change. These rules are insisted on, as necessary to preserve the illusion of the scene; but in many cases they must obviously tend to destroy it. In order to contrive the incidents of a fable to pass within the time prescribed, many important scenes must be related, instead of being represented; and to bring all the persons concerned in the drama to one spot, during that time, many violations of probability must be made. Hence it is, that the regular tragedies of the French school are so barren of incident, and so replete with tedious declamation. The choice of a subject is there controlled by the laws of time and place; whereas the observance of those laws should be regulated by the nature of the subject. Perhaps there is not a more genuine tragedy than Shakespeare's "Lear;" yet how vain would be the attempt to new model it by the rules, and render it equally sublime and affecting. The powers of the immortal author himself would be inadequate to such a task.

The unity of action alone is in all cases indispensable. A tragedy is something more than a history: it is a tissue of events not merely succeeding each other, but arising out of each other. It is one whole and entire action, developed by a series of incidents which sustain it to the end, and which concur all to the same point. If an episode or underplot is introduced, it must be rendered auxiliary to the main story, so as not to be suppressed without injury to it; otherwise it must necessarily constitute an independent action of itself, and the unity of the subject would be broken.

The exposition, or opening of the fable, was assigned by the ancients to the prologue; with the moderns it is comprehended in the first act. This act should form the basis of the rest, both with regard to the main action, and to the episodes, so that no actor should enter in the subsequent acts, who has not been introduced or mentioned in the first.

By the intrigue is meant that concatenation of facts or incidents, whose perplexity arrests for a time the progress of the action. Thus, the difficulties attending a principal personage in the tragedy constitute what is properly called the intrigue; and it is this which keeps the spectator in suspense, and gradually raises his curiosity to the highest pitch, by the variety of emotions, interests, and passions which it involves. For instance, in the tragedy of "Othello," the circumstances attending the Moor's jealousy strengthens his suspicions by degrees, and render him "perplexed in the extreme." Here lies the intrigue of the piece.

The *denouement* is the unravelling of the intrigue. It ought to arise naturally from what precedes, and should be quite unforeseen, because all interest is sustained by the uncertainty of the mind, between fear and hope. There are instances, however, where the *denouement*, although foreseen, is nevertheless interesting. With regard to what is called poetical justice, we may observe, that although it may be most grateful to behold virtue triumphant and vice disgraced, yet the drama, to be a picture of human life, must sometimes exhibit the reverse; in these cases it will not be without its use, if it direct our view to "something after death."

The division into acts is purely arbitrary, and seems to have been unknown on the Grecian stage. Aristotle makes no such distinction; he speaks only of the duration of the piece, which has naturally only three parts, a beginning, a middle, and an end. Horace insists, that there shall be neither more nor less than five acts; and to this rule most of the moderns have adhered.

Of the style best adapted to tragedy, it were trite to say, that it should be appropriate to the characters. It may be lofty, it may be elegant, but it must always appeal directly to the heart. The

most pathetic scenes of our tragic poets are written in language very little elevated above the dialogue of real life; and to this language Shakespeare has, by a combination and a phraseology peculiar to himself, imparted new powers, for he has expressed in it some of the sublimest conceptions of human genius.

TRAGIA, in botany, so named in memory of Hieronymus Tragus, a genus of the Monoecia Triandria class and order. Natural order of Tricoccæ. Euphorbiæ, Jussieu. Essential character: male, calyx three-parted; corolla none; female, calyx five-parted; corolla none; style trifid; capsule tricoccous, three-celled; seeds solitary. There are eight species, natives of the East and West Indies.

TRAGOPOGON, in botany, *goats-beard*, a genus of the Syngenesia Polygamia Æqualis class and order. Natural order of Compositæ Semiflosculosæ. Cichoraceæ, Jussieu. Essential character: calyx simple; down feathered: receptacle naked. There are fourteen species.

TRAJECTORY *of a comet*, is its path or orbit, or the line it describes in its motion. This path is supposed, by Hevelius, to be nearly a right line. Dr. Halley assumes it to be a very eccentric ellipse; but says, it may often be computed on the supposition of its being a parabola. Sir Isaac Newton shows how to determine the trajectory of a comet from three observations. See "Principia," book 3, Prop. 41.

TRAIN, the attendance of a great person, or the trail of a gown, or robe of state. In falconry, it denotes the tail of a hawk.

Train is likewise used for the number of beats which a watch makes in an hour, or any other certain time.

Train is also used for a line of gunpowder, laid to give fire to a quantity thereof, in order to do execution by blowing up earth, works, buildings, &c.

Train, or Traile *of artillery*, includes the great guns, and other pieces of ordnance, belonging to an army in the field. See Cannon.

Train *oil*, the oil procured from the blubber of a whale by boiling. See the articles Oil.

Train *bands*, or Trained *bands*, a name given to the militia of England.

TRAINING, or Tracing, in mineralogy, a term used by the miners, to express the tracing up the mineral appearances on the surface of the earth to their head, or original place, and there finding a mine of the metal they contain.

TRAMEL, an instrument or device, sometimes of leather, more usually of rope, fitted to a horse's legs, to regulate his motions, and form him to an amble. It is also taken in many places for an iron moveable instrument in chimnies, to hang pots over the fire.

Tramel *net*, is a long net wherewith to take fowl by night, in champaign countries, much like the net used for the low bell, both in shape, bigness, and mashes. To use it, they spread it on the ground, so as the nether, or further end, fitted with small plummets, may lie loose thereon; then the other part, being borne up by men placed at the fore ends, it is thus trailed along the ground. At each side are carried great blazing lights, by which the birds are raised, and as they rise under the net they are taken.

TRAMMELS, in mechanics, an instrument used by artificers for drawing ovals upon boards. It consists, on one part, of a cross with two grooves at right angles; the other is a beam carrying two pins which slide in those grooves, and also the describing pencil. Engines in general, intended for turning ovals, are constructed on the same principles with trammels: the only difference is, that in the trammels the board is at rest, and the pencil moves upon it: in the turning engine, the tool which supplies the place of the pencil is at rest, and the board moves against it. See Lathe and Turning.

TRANSACTIONS, *philosophical*, a kind of journal of the principal things that come before the Royal Society of London. See Society. It appears, that the printing of these transactions was always, from time to time, the single act of the respective secretaries of the Society, till the publication of the 47th volume, in 1753; notwithstanding it has been the common opinion, that they were published by the authority, and under the direction, of the Society itself. The truth is, that the Society, as a body, never did interest themselves further in their publication, than by occasionally recommending the revisal of them to some of their secretaries, when, from the particular circumstances of their affairs, the transactions had happened for any length of time to be intermitted; and this seems principally to have been done with a view to satisfy the public, that their usual meetings were then continued for the improvement of knowledge, and benefit of mankind, the great ends of their first institution; but the Society being of late years greatly enlarged, and their communications more numerous,

they thought it advisable, that a committee of their members should be appointed to reconsider the papers read before them, and select out of them such as they should judge proper for publication in the future transactions, which was accordingly done upon the 26th of March, 1752.

The transactions are now usually published in half volumes twice a year, and each member is entitled to receive one copy gratis, of every part published after his admission into the Society. The volumes have lately been abridged by Dr. Hutton and others. Those published before the year 1750, were abridged in eleven volumes, quarto, by Mr. Jones, Mr. Eames, and Mr. Martyn.

TRANSCENDENTAL, or TRANSCENDANT, something elevated or raised above other things; which passes and transcends the nature of other inferior things. Transcendental quantities, among geometricians, are indeterminate ones, or such as cannot be fixed or expressed by any constant equation: such are all transcendantal curves, which cannot be defined by any algebraic equation; or which, when expressed by an equation, one of the terms thereof is a variable quantity. Now whereas algebraists use to assume some general letters or numbers, for the quantity sought in these transcendental problems, Mr. Leibnitz assumes general or indefinite equations for the lines sought; *e. gr.* putting x and y for the absciss and ordinate; the equation he uses for a line sought, is $a + bx + cy + exy + fxx + gyy$, &c.$=o$, by the help of which indefinite equation he seeks the tangent; and by comparing the result with the given property of tangents, he finds the value of the assumed letters, a, b, c, d, &c. and thus defines the equation of the line sought.

If the comparison above-mentioned do not proceed, he pronounces the line sought not to be an algebraical, but a transcendental one. This supposed, he goes on to find the species of transcendency: for some transcendentals depend on the general division or section of a ratio, or upon the logarithms; others upon the arcs of a circle; and others on more indefinite and compound enquiries. He therefore, besides the symbols, x and y, assumes a third, as v, which denotes the transcendental quantity; and of these three, forms a general equation for the line sought, from which he finds the tangent, according to the differential method, which succeeds even in transcendental quantities. The result he compares with the given properties of the tangent, and so discovers, not only the values of a, b, c, d, &c. but also the particular nature of the transcendental quantity. And though it may sometimes happen, that the several transcendentals are so to be made use of, and those of different natures too, one from another; also, though there be transcendents of transcendentals, and a progression of these *in infinitum;* yet we may be satisfied with the most easy and useful one; and for the most part, may have recourse to some peculiar artifices for shortening the calculus, and reducing the problem to as simple terms as may be.

This method being applied to the business of quadratures, or to the invention of quadratics, in which the property of the tangent is always given, it is manifest, not only how it may be discovered, whether the indefinite quadrature may be algebraically impossible; but also, how, when this impossibility is discovered, a transcendental quadratrix may be found, which is a thing not before shown. So that it seems, that geometry, by this method, is carried infinitely beyond the bounds to which Vieta and Des Cartes brought it; since, by this means, a certain and general analysis is established, which extends to all problems of no certain degree, and consequently not comprehended within algebraical equations.

Again, in order to manage transcendental problems, wherever the business of tangents or quadratures occurs, by a calculus, there is hardly any that can be imagined shorter, more advantageous, or more universal, than the differential calculus, or analysis of indivisibles and infinites. By this method we may explain the nature of transcendental lines, by an equation; *e. gr.* let a be the arch of a circle, and x the versed sine; then will $a = \dfrac{\mathrm{S}\, dx}{\sqrt{2x - xx}}$; and if the ordinate of the cycloid be y, then will $y = \sqrt{2x - xx} + \dfrac{\mathrm{S}\, dx}{\sqrt{2x - xx}}$; which equation perfectly expresses the relation between the ordinate, y, and the absciss, x, and from it all the properties of the cycloid may be demonstrated.

Thus is the analytical calculus extended to those lines which have hitherto been excluded; for no other reason, but that they were thought incapable of it.

TRANSCRIPT, a copy of any original writing, particularly that of an act or in-

strument inserted in the body of another.

TRANSFER, in commerce, &c. an act whereby a person surrenders his right, interest, or property, in any thing moveable, or immoveable, to another. The term transfer, is chiefly used for the assigning and making over shares in the stocks, or public funds, to such as purchase them of the proprietors.

TRANSFORMATION, in general, denotes a change of form, or the assuming a new form different from a former one. The chemists were a long time seeking the transformation of metals; that is, their transmutation, or the manner of changing them into gold. See TRANSMUTATION.

TRANSFORMATION *of equations.* The doctrine of the transformation of equations, and of exterminating their intermediate terms, is thus taught by Mr. Mac Laurin. The affirmative roots of an equation are changed into negative roots of the same value, and the negative roots into affirmative, by only changing the signs of the terms alternately, beginning with the second. Thus the roots of the equation, $x^4 - x^3 - 19x^2 + 49x - 30 = 0$, are $+1, +2, +3, -5$; whereas the roots of the same equation, having only the signs of the second and fourth terms changed, *viz.* $x^4 + x^3 - 19x^2 - 49x - 30 = 0$, are $-1, -2, -3, +5$.

To understand the reason of this rule, let us assume an equation, as $\overline{x-a} \times \overline{x-b} \times \overline{x-c} \times \overline{x-d} \times \overline{x-e}$, &c. $= 0$, whose roots are $+a, +b, +c, +d, +e$, &c.: and another, having its roots of the same value, but affected with contrary signs, as $\overline{x+a} \times \overline{x+b} \times \overline{x+c} \times \overline{x+d} \times \overline{x+e}$, &c. $= 0$. It is plain, that the terms taken alternately, beginning from the first, are the same in both equations, and have the same sign, being products of an even number of the roots; the product of any two roots having the same sign as their product when both their signs are changed; as $+a \times -b = -a \times +b$.

But the second terms, and all taken alternately from them, because their coefficients involve always the products of an odd number of the roots, will have contrary signs in the two equations. For example: the product of four, *viz.* $a\,b\,c\,d$, having the same sign in both, and one equation in the fifth term having $a\,b\,c\,d \times +e$, and the other $a\,b\,c\,d \times -e$, it follows, that their product, $a\,b\,c\,d\,e$, must have contrary signs in the two equations: these two equations, therefore, that have the same roots, but with contrary signs, have nothing different but the signs of the alternate terms, beginning with the second. From which it follows, that if any equation is given, and you change the signs of the alternate terms, beginning with the second, the new equation will have roots of the same value, but with contrary signs.

TRANSIT, in astronomy, signifies the passage of any planet, just by, or over a fixed star, or the sun, and of the moon in particular, covering or moving over any planet. See VENUS.

TRANSITION, in rhetoric, is of two sorts. The first is when a speech is introduced abruptly, without express notice given of it; as when Milton gives an account of our first ancestors' evening devotions.

"Both turn'd, and under open sky ador'd
The God that made both air, sky, earth,
and heaven.—
——Thou also mad'st the night,
Maker omnipotent, and thou the day!"

The second sort of transition is, when a writer suddenly leaves the subject he is upon, and passes unto another, from which it seems different at first view, but has a relation and connexion with it, and serves to illustrate and enlarge it.

TRANSITIVE, in grammar, an epithet applied to such verbs as signify an action which passes from the subject that does it, to or upon another subject which receives it. Under the head of verbs transitive, come what we usually call verbs active and passive; other verbs, whose action does not pass out of themselves, are called neuters, and by some grammarians, intransitives.

TRANSMISSION, in optics, &c. the act of a transparent body passing the rays of light through its substance, or suffering them to pass; in which sense the word stands opposed to reflection. Transmission is also frequently used in the same sense with refraction, by which most bodies, in transmitting the rays, do also refract them. For the cause of transmission, or the reason why some bodies transmit, and others reflect the rays, see OPACITY.

TRANSMUTATION, the act of transforming, or changing one nature into another. Nature, Sir Isaac Newton observes, seems delighted with transmutations: he goes on to enumerate several kinds of natural transmutations; gross bodies, and light, he suspects, may be mu-

tually transmuted into each other; and adds, that all bodies receive their active force from the particles of light which enter their composition. For all fixed bodies, when well heated, emit light as long as they continue so; and again, light intermingles itself, and inheres in bodies, as often as its rays fall on the solid particles of those bodies. Again, water, which is a fluid, volatile, tasteless salt, is by heat transmuted into a vapour, which is a kind of air, and by cold, into ice, which is a cold transparent brittle stone, easily dissolvable, and this stone is convertible again into water by heat, as vapour is by cold.

Transmutation, in alchemy, denotes the art of changing or exalting imperfect metals into gold or silver. This is also called the grand operation, and, they say, is to be effected with the philosopher's stone. See Alchemy.

Transmutation, in geometry, denotes the reduction or change of one figure or body into another of the same area or solidity, but of a different form: as a triangle into a square, a pyramid into a parallelopiped, &c. In the higher geometry, transmutation is used for the converting a figure into another of the same kind and order, whose respective parts rise to the same dimensions in an equation, admit of the same tangents, &c. If a rectilinear figure be transmitted into another, it is sufficient that the intersections of the lines which compose it be transferred, and the lines drawn through the same in the new figure. If the figure to be transmuted be curvilinear, the points, tangents, and other right lines, by means whereof the curve line is to be defined, must be transferred.

TRANSOM, among builders, denotes the piece that is framed across a double light window.

Transom, among mathematicians, signifies the vane of a cross-staff, or a wooden number fixed across, with a square, whereon it slides, &c.

Transom, in a ship, a piece of timber which lies athwart the stern, between the two fashion-pieces, directly under the gun-room port.

TRANSPARENCY, in physics, a quality in certain bodies whereby they give passage to the rays of light, in contradistinction to opacity, or that quality of bodies which renders them impervious to the rays of light. See Opacity.

TRANSPOSITION, in algebra, the bringing any term of an equation over to the other side. See Algebra and Equation.

TRAPA, in botany, *water caltrops*, a genus of the Tetrandria Monogynia class and order. Natural order of Hydrocharides, Jussieu. Essential character: calyx four-parted; corolla four-petalled; nut girt with four opposite spines, which were the leaves of the calyx. There are two species, *viz.* T. natans, four-horned water caltrops; and T. bicornis, two-horned water caltrops.

TRANSVERSE, something that goes across another, from corner to corner: thus bends and bars, in heraldry, are transverse pieces or bearings: the diagonals of a parallelogram or a square, are transverse lines: lines which make intersections with perpendiculars, are also called oblique or transverse lines.

TRAP, in mineralogy, is a Swedish term signifying stair. It was first applied to designate a certain class of mountains, composed of nearly horizontal strata, with perpendicular breaks, which were supposed to give a rude resemblance to a flight of stairs. Hence many species of rock, differing very much from each other, were called by the same name, which caused much confusion. According to Werner, there are three distinct classes or formations of rocks to which the term trap may be applied: of these the first class belongs to the primitive mountains, the second to the transition mountains, and the third to the secondary mountains. Primitive traps are composed essentially of hornblende, mingled with felspar, and sometimes with pyrites and mica. Of rocks belonging to this formation there are four distinct species, *viz.* the common hornblende, the schistose hornblende, primitive grünstein, and schistose grünstein. Transition traps are composed principally of granular grünstein, but the mixture of the ingredients is more intimate, the grain is finer, and the mass appears more homogeneous. There are two principal varieties, *viz.* 1. The amygdaloid, which is a rock of schistose hornblende in a state of semi-decomposition, resembling fine ferruginous clay. It contains a number of globular cavities, from the size of a pea to that of a small apple: of these cavities some contain nothing but air, and are coated on the inside with a kind of varnish; others contain balls of calcareous spar, quartz, chalcedony, &c. The toadstone of Derbyshire is considered by Werner as belonging to this variety. 2. Globular trap, composed of schistose

grünstein, in a state of semi-decomposition, arranged in spheroids of various magnitudes, and composed of thick concentric lamellar distinct concretions. Secondary or floetz traps are divided into those which are peculiar and characteristic of it, and those which are accidental. The former are basalt, porphyry, &c. Among the latter may be classed rubble and sandstone, clay, coal, and bituminous wood. The proper base to the secondary trap formation, or in other words the substance, which appears to have immediately preceded it in the order of formation, is secondary limestone; it is, however, not unfrequently found resting on sandstone, on argillite, on gneiss, and even on granite. The general order in the strata of this formation, is the following, *viz.* coarse sand, fine sand, sandy clay, unctuous clay, wakke, basalt, amygdaloid, porphyry, and grünstein. It hardly ever happens that all these strata are met with in the same mass of mountain. No metallic veins are found in this class of mountains, but the remains of vegetable and marine organized bodies are of frequent occurrence. See Rock.

TRAPEZIUM, in geometry, a plane figure contained under four unequal right lines. 1. Any three sides of a trapezium taken together, are greater than the fourth. 2. The two diagonals of any trapezium, divide it into four proportional triangles. 3. If two sides of a trapezium be parallel, the rectangle under the aggregate of the parallel sides and one half their distance is equal to that trapezium. 4. If a parallelogram circumscribes a trapezium, so that one of the sides of the parallelogram be parallel to a diagonal of the trapezium, that parallelogram will be the double of the trapezium. 5. If any trapezium has two of its opposite angles, each a right angle, and a diagonal be drawn joining these angles; and if from the other two angles be drawn two perpendiculars to that diagonal, the distances from the feet of these perpendiculars to those right angles, respectively taken, will be equal. 6. If the sides of a trapezium be each bisected, and the points of bisection be joined by four right lines, these lines will form a parallelogram, which will be one half of the trapezium. 7. If the diagonals of a trapezium be bisected, and a right line joins these points, the aggregate of the squares of the sides is equal to the aggregate of the squares of the diagonals, together with four times of the square of the right line joining the point of bisection. 8. In any trapezium, the aggregate of the diagonals is less than the aggregate of four right lines drawn from any point (except the intersection of the diagonals) within the figure.

TRAVELLER, in naval affairs, one or more iron thimbles, with a rope spliced round them, sometimes forming a kind of tail, but more generally a species of grommet, and used on various occasions.

TRAVERSE, or Transverse, in general, denotes something that goes athwart another; that is, crosses and cuts it obliquely.

Hence, to traverse a piece of ordnance, among gunners, signifies to turn or point it which way one pleases, upon the platform.

In fortification, traverse denotes a trench, with a little parapet, or bank of earth, thrown perpendicularly across the moat, or other work, to prevent the enemy's cannon from raking it. These traverses may be from twelve to eighteen feet, in order to be cannon proof; and their height about six or seven feet, or more, if the place be exposed to any eminence.

Traverse, in navigation, is a compound course, wherein several different successive courses and distances are known. To work a traverse, or to reduce a compound course to a single one, 1. Make a table of six columns, marked, course; distance; N. S. E. W. beginning at the left hand, and write the given courses and distances in their proper columns. 2. seek the given courses and distances in the traverse table, and let the corresponding differences of latitude and departure be written in their proper columns in the table made for the question. 3. Add up the columns of northing, southing, easting, and westing; then the difference between the sums of northing and southing gives the whole difference of latitude, which is of the same name with the greater; and the difference between the sums of easting and westing will be the whole departure, which is likewise of the same name with the greater. 4. The whole difference, latitude, and departure to the compound course being found, the direct course and distance will be found by Case IV. of plain-sailing. See Navigation, &c.

Traverse, in law, signifies sometimes to deny, sometimes to overthrow or undo a thing, or to put one to prove some matter; much used in answers to bills in chancery; or it is that which the defendant pleads, or says in bar, to avoid the plaintiff's bill, either by confessing and

avoiding, or by denying and traversing the material parts thereof. Traverse is also to take issue upon the chief matter, and to contradict or deny some point of it. To traverse an office, is to prove that an inquisition made of lands or goods, by escheator, is defective and untruly made.

TREASON, in law, is divided into high treason and petty treason. High treason is defined to be an offence committed against the security of the King or kingdom, whether it be by imagination, word, or deed; as to compass or imagine the death of the King, Queen, or Prince, or to deflower the King's wife, or his eldest daughter unmarried; or his eldest son's wife; or levy war against the king in his realm, adhere to his enemies, counterfeit his great seal, privy seal, or money, or wittingly to bring false money into this realm, counterfeited like the money of England, and utter the same; to kill the King's Chancellor, Treasurer, Justices of either bench, Justices in Eyre, of Assize, or of Oyer and Terminer, being in their place doing this office; forging the King's sign manuel or privy signet, privy seal, or foreign coin current here, or diminishing or impairing current money. In case of treason, a man shall be drawn, hanged, and quartered, and forfeit his lands and goods to the King. 25 Edward III.

Treason, *petit.* Whenever a wife murders her husband, a servant his master or mistress, or an ecclesiastic a prelate, or to whom he owes obedience, every one of these offences is petit treason.

As every petit treason implies a murder, it follows that the mere killing of an husband, master, or prelate, is not always petit-treason; for if there are not such circumstances in the case of killing one of these persons, as would have made it murder in the case of killing any other person, it does not amount to this offence.

There can be no accessary in high treason. And it seems to be always agreed, that what would have made a man an accessary before the fact in any other felony, makes him a principal in high treason.

As the person of his Majesty was imagined in imminent danger, it was thought necessary to enact two late statutes, *viz.* 36 George III. c. 7, and 36 George III. c. 8; the former to enlarge the clauses in the statute 25 Edward III. for the greater safety of his Majesty's person; the latter for the preventing seditious meetings. But on account of the too great length of the acts we are obliged to refer the reader to them. There is nothing so dangerous, in a constitutional point of view, as what are called constructive treasons, by which persons are held guilty of treason, upon something constructively deemed dangerous to the safety of the King.

TREASURE *trove*, is where any money or coin, gold, silver, plate, or bullion, is hidden in the earth, or other private place, the owner thereof being unknown; in which case, the treasure belongs to the King, or some other who claims by the King's grant, or by prescription. But if he that hid it be known, or afterwards found out, the owner and not the King is entitled to it. If it be found in the sea, or upon the earth, it doth not belong to the King, but to the finder, if no owner appear.

TREASURER, an officer to whom the treasure of a prince or corporation is committed to be kept, and duly disposed of. The Lord High Treasurer of Great Britain, or first Commissioner of the Treasury, when in commission, has under his charge and government all the King's revenue, which is kept in the Exchequer. He holds his place during the King's pleasure, being instituted by the delivery of a white staff to him: he has the check of all the officers employed in collecting the customs and other royal revenues; and in his gift and disposition are all the offices of the customs in the several ports of the kingdom; escheators in every county are nominated by him; he also makes leases of the lands belonging to the crown. There is, besides the Lord Treasurer, a Treasurer of the King's Household, who is of the Privy Council, and, with the Comptroller and Steward of the Marshalsea, has great power. To these may be added the Treasurer of the navy; as also the Treasurer of the King's Chamber, and of the wardrobe; and most corporations throughout the kingdom have treasurers, whose office is to receive their rents, and disburse their common expences. The Treasurer of the County, is an officer that keeps the county-stock, in which office there are two in every county, who are chosen by the major part of the justices of the peace at Easter-sessions. They ought to have certain estates in lands, or to be worth 150*l.* in personal estate, and are to continue in their office only for a year, at the end whereof, or within ten days after the expiration of the year, they must account to their successors, under certain penalties. The county-stock which this officer has the keeping of, is raised

by rating every parish annually; and the same is from time to time disposed of to charitable uses, towards the relief of maimed soldiers and mariners, prisoners in the county goals, paying the salaries of governors of houses of correction, and relieving poor alms-houses, &c.

TREES. See TIMBER.

TREMOLITE, in mineralogy, is a species of the Talc genus, of which there are three sub-species, *viz.* the asbestos, the common, and the glassy; the colours of the last are yellowish, reddish, grey, and green; it occurs massive and crystallized; it is easily frangible, and not very heavy; its constituent parts are,

Silica	65.00
Magnesia	10.33
Lime	18.00
Oxide of iron	0.16
Water and carbonic acid	6.50
	99.99

It is said to emit a phosphoric light when rubbed in the dark. Before the blow-pipe it melts without addition into a cellular white coloured scoria. It is found principally in primitive mountains, and is there usually imbedded in limestone; it is found in many parts of Germany, in the Shetland islands, and in the basaltic rock on which the castle of Edinburgh is built.

TRENCHES, in fortification, are ditches cut by the besiegers, that they may approach more securely to the place attacked; whence they are also called lines of approach. The tail of the trench is the place where it was begun, and its head is the place where it ends. The trenches are usually opened, or begun, in the night-time; sometimes within musket shot, and sometimes within half or whole cannon shot of the place. They are carried on in winding-lines, nearly parallel to the works of the fortress, so as not to be in the view of the enemy, nor exposed to the enemy's shot. The workmen employed in the trenches are always supported by a number of troops, to defend them against the sallies of the besieged; the pioneers sometimes work on their knees, and are usually covered with mantlets or faucissons; and the men who support them lie flat on their faces, in order to avoid the enemy's shot.

TRESPASS, is any transgression of the law, under treason, felony, or misprision of either. Trespass signifies going beyond what is lawful; hence it follows, that every injurious act is, in the large sense of this word, a trespass. But as many injurious acts are distinguished by particular names, as treason, murder, rape, and other names, the legal sense of the word trespass is confined to such injurious acts as have not acquired a particular name. Some trespasses are not accompanied with any force; a trespass of this sort is called a trespass upon this case; and the proper remedy for the party injured, is by an action upon the case. Other trespasses are accompanied with force, either actual or implied. If a trespass, which was accompanied with either actual or implied force, have been injurious to the public, the proper remedy in every such case is by an indictment, or by information. And if a trespass that was accompanied with an actual force, have been injurious only to one or more private persons, the offender is in every such case liable to an indictment, or to an information; for although the injury has in such case been only done to one or more private persons, as every trespass accompanied with actual force is a breach of the peace, it is to be considered and punished as an offence against the public.

A man is answerable for not only his own trespass, but that of his cattle also. And the law gives the party injured a double remedy in this case, by permitting him to distrain the cattle, thus doing damage, till the owner shall make him satisfaction. And in either of these cases of trespass committed on another's land, either by a man himself or his cattle, the action that lies is the action of trespass, with force and arms; for the law always couples the idea of force with that of intrusion upon the property of another. In some cases trespass is justifiable; or rather entry on another's land or house shall not in these cases be accounted trespass; as if a man came there to demand or pay money there payable, or to execute in a legal manner the process of the law. To prevent trifling and vexatious actions of trespass, it is enacted, by 43 Eliz. c. 6, 22 and 23 Charles II. c. 9, and 8 and 9 William c. 2, that where a jury who try an action of trespass give less damages than 40*s.* the plaintiff shall be allowed no more costs than damages, unless the judge shall certify on the back of the record, that the freehold or title of the land came chiefly in question. But if it shall appear, that the trespass was wilful and malicious, the plaintiff shall have his full costs. And every trespass is wilful, where the defendant has been forewarn-

ed; and malicious, where the intent of the defendant appears to be to harass or injure the plaintiff.

TRET, in commerce, an allowance made for the waste, or the dirt, that may be mixed with any commodity, which is always four pounds in every one hundred and four pounds weight. See TARE.

TREWIA, in botany, a genus of the Monoecia Polyandria class and order. Essential character: calyx three-leaved, superior; corolla none; capsule tricoccous. There is only one species, *viz.* T. nudiflora; this is a lofty tree, with a thick trunk, covered with an ash-coloured bark; leaves on long round petioles, oblong, ovate, cordate, attenuated at the point; dusky green on the upper surface, but brighter on the lower; flowers on round pale green peduncles, axillary, of an herbaceous colour, void of scent. Native of the East Indies.

TRIAL, the proceeding of a court of law, when the parties are at issue, such as the examination of witnesses, &c. to enable the court, deliberately weighing the evidence given on both sides, to draw a true conclusion, and administer justice accordingly.

TRIANDRIA, in botany, the name of the third class in the Linnæan system, consisting of plants with hermaphrodite flowers, which have three stamina or male organs. There are three orders in this class, derived from the number of styles.

TRIANGLE, in geometry, a figure of three sides and three angles. Triangles are either plane or spherical. A plane triangle is contained under three right lines; and a spherical one is a triangle contained under three arches of great circles of the sphere. Triangles are denominated, from their angles, right, obtuse, and acute. A right-angled triangle is that which has one right angle. An obtuse-angled triangle is such as has one obtuse angle. And an acute-angled triangle is that which has all its angles acute.

In every triangle the sines of the sides are proportional to the sines of the opposite angles; also the sine of all the three angles is equal to two right ones; and the external angle, made by any side produced, is equal to the sum of the two internal and opposite angles. Triangles on the same base, and having the same height or place, between the same parallels, are equal; also triangles on equal bases, and between the same parallels, are equal. If a perpendicular be let fall upon the base of an oblique-angled triangle, the difference of the squares of the sides is equal to the double-rectangle under the base, and the distance of the perpendicular from the middle of the base. The side of an equilateral triangle, inscribed in a circle, is in power triple of the radius. The sides of a triangle are cut proportionably, by a line drawn parallel to its base. A whole triangle is to a triangle cut off by a right line drawn parallel to the base, as the rectangle under the cut sides is to the rectangle of the two other sides. In a right-angled triangle, a line drawn from the right angle at the top, perpendicular to the hypothenuse, divides the triangle into two other right-angled triangles, which are similar to the first triangle, and to one another. In every right-angled triangle, the square of the hypothenuse is equal to the sum of the squares of the other two sides; and, in general, any figure described on the hypothenuse, is equal to the sum of two similar figures described upon the two sides. In an isosceles triangle, that is, a triangle having two of its sides equal, if a line be drawn from the vertex to any point in the base, the square of that line together with the rectangle of the segments of the base, is equal to the square of the side. If one angle of a triangle be equal to 120°, the square of the base will be equal to the squares of both sides, together with the rectangle of those sides; and if those sides be equal to each other, then the square of the base will be equal to three times the square of one side, or equal to twelve times the square of the perpendicular from the angle upon the base.

If any angle of a triangle be bisected, the bisecting line will divide the opposite side in the same proportion as the legs of the angle are to one another. Every triangle is one half of a parallelogram of the same base and height. The area of any triangle may be had by adding all the three sides together, and taking half the sum, and from that half subtracting each side severally, and multiplying that half sum and the remainder continually into one another, and extracting the square root of the product. See TRIGONOMETRY.

TRIANGLE, in astronomy, one of the forty-eight ancient constellations, situated in the northern hemisphere. There is also a southern triangle, in the other hemisphere. According to the British cata-

logue, there are sixteen stars in the northern; and in Sharp's catalogue there are five in the southern triangle.

TRIANGULAR *compasses*, are such as have three legs, or feet, whereby to take off any triangle at once; much used in the construction of maps, globes, &c.

TRIANGULAR *numbers*, are a kind of polygonal numbers, being the sums of arithmetical progressions, the difference of whose terms is 1.

Thus from the arithmetical numbers 1, 2, 3, 4, 5, 6, are formed the triangular numbers, 1, 3, 6, 10, 15, 21. The sum of any number n of the terms of the said triangular numbers is $= \frac{n}{1} \times \frac{n+1}{2} \times \frac{n+2}{3}$ if n be 5, the sum will be 35, which is also equal to the sum of the number of shot in a triangular pile of balls, the number of rows, or the number in each side of the base, being n. The sum of the reciprocals of the triangular series infinitely continued, is equal to $2 = 1 + \frac{1}{3} + \frac{1}{6} + \frac{1}{10}$, &c.

TRIANGULAR *canon*, the tables of artificial sines, tangents, secants, &c.

TRIANGULAR *quadrant*, is a sector furnished with a loose piece, whereby to make it an equilateral triangle.

The calendar is graduated thereon, with the sun's place, declination, and other useful lines: and by the help of a string and a plummet, and the divisions graduated on the loose piece, it may be made to serve for a quadrant.

TRIANTHEMA, in botany, a genus of the Decandria Digynia class and order. Natural order of Succulentæ. Portulaceæ, Jussieu. Essential character: calyx mucronate below the tip; corolla none; stamina five or ten; germ retuse, capsule cut round. There are seven species.

TRIBOMETER, a term applied by Muschenbroek and others to an instrument invented for measuring the friction of metals. It consists of an axis formed of hard steel, passing through a cylindrical piece of wood; the ends of the axis, which are highly polished, are made to rest on the polished semicircular cheeks of various metals; and the degree of friction is estimated by means of a weight suspended by a fine silken string or ribband over the wooden cylinder.

TRIBULUS, in botany, *caltrops*, a genus of the Decandria Monogynia class and order. Natural order of Gruinales. Rutaceæ, Jussieu. Essential character: calyx five-parted; petals five, spreading; style none; capsule five, gibbous, spiny, many-seeded. There are four species.

TRICERA, in botany, a genus of the Monoecia Tetrandria class and order. Natural order of Tricoccæ. Euphorbiæ, Jussieu. Essential character: male, calyx four-leaved; corolla none; filaments ovate; female, calyx five-leaved; corolla none; styles conical; capsule three-horned, three-celled. There is only one species, *viz.* T. lævigata, a native of Jamaica, in mountain coppices in the western parts of the island, flowering in the spring months.

TRICHECUS, the *walrus*, in natural history, a genus of Mammalia of the order Bruta. Generic character: no fore-teeth in the full grown animal, above or below; tusks in the upper jaw solitary; grinders with wrinkled surfaces; body oblong; lips doubled; hind feet stretched, uniting into a fin. These animals are all natives of the sea, and feed on sea-weeds and shell-fish, but are never known to eat flesh. There are three species, of which the principal is T. rosmarus, the arctic walrus, or the morse. This is an animal of a very inelegant structure. It has a small head to a vast body. Its under lip is covered with bristles nearly of the thickness of a crow-quill. In its upper jaw it has two large tusks from one to two feet in length, and weighing from three to twenty pounds. The walrus sometimes grows to the length of eighteen feet, and the circumference, about the thickest part, of twelve. It is principally found in the high latitudes of the Northern Ocean. These animals are gregarious, and are often seen upon floating masses of ice, in immense numbers, the greater part sleeping, but some always on the watch, to give notice of approaching danger. They are harmless when not provoked; but some accounts represent them as highly formidable in a state of irritation, the efforts of many being combined against the enemy, and fastening with their teeth against boats to make holes in them, or draw them to the bottom. Others represent them as less agitated by the fury of passion, and as inclined more to flight than revenge, adding, that they are terrified by the slightest flash, and even the pointing of a musket will drive them in a moment out of sight. Their tusks serve the purposes of aiding their movements upon the ice, into which they are stuck, and on which they thus secure their hold, and sometimes drag on their unweildy bodies. The tusks are

convertible to the purposes of ivory, and these animals are destroyed for the profit derivable partly from these tusks, but principally for the sake of their oil, of which a full grown walrus will yield a butt. The skin may be manufactured into a very strong leather. The affection between the female and its young one, for it has seldom more than one at a birth, is such that they are said never to separate, and that when one is killed the survivor refuses to quit the dead body, and is considered by the hunter as his secure prey. The walrus has been called, with little resemblance to justify the name, the sea-horse; it is more similar to a cow, but most of all to a seal. See Mammalia, Plate XXI. fig. 3.

T. borealis, or the whale-tailed manati, inhabits the seas between Kamtschatka and America. These animals live in families, generally consisting of a male and a female, and two young ones of different ages; and the attachment of the male to the female is so great, that he will defend her when attacked to the last extremity; and if she happens to be destroyed and dragged to the shore, he will swim for some days off the fatal and detested spot. The manati approaches very nearly to the cete tribe, and its feet are little more than pectoral fins. It attains the immense length of twenty-seven feet, and the weight of four tons. In winter it is extremely lean, and its ribs may be distinctly numbered. It will, when pierced with the harpoon, sometime adhere to rocks with its feet with uncommon tenacity, and when forced from them by a cord drawn by thirty men or more, is found to have left part of the skin of the feet behind. When any individual is harpooned, others are stated to swim to its aid, endeavouring, some to overturn the boat, others to break the cord, and others again, by blows with their tails, striving to dislodge the harpoon. Their sounds somewhat resembling the snorting of a horse. They are never seen on land.

TRICHILIA, in botany, a genus of the Decandria Monogynia class and order. Natural order of Trihilatæ. Meliæ, Jussieu. Essential character: calyx mostly five-toothed; petals five; nectary toothed, cylindrical, bearing the anthers at the top of the teeth; capsule three-celled, three-valved; seeds buried. There are twelve species.

TRICHIURUS, the *trichiure*, in natural history, a genus of fishes of the order Apodes. Generic character: head lengthened; the gill-covers lateral; teeth ensiformed, and hooked on one side; gill membrane seven-rayed; body compressed and ensiform; tail subulate and without fins. There are two species. T. argenteus, or the silver trichiure, is about two feet and a half long, and inhabits the lakes and rivers of South America, and of some parts of Asia. Its colour of a bright silver; its body tapers gradually, and terminates in an absolute point; its dorsal fin extends nearly through the animal's whole length. It is a fish remarkable for its voracity, and has been known to leap into boats in quest of prey. It is used for the table. The T. electricus is of the same size with the former; but differs in several circumstances relating to the teeth, jaws, and tail. It is supposed to possess an electrical power.

TRICHOCARPUS, in botany, a genus of the Polyandria Digynia class and order. Essential character: calyx four or five-parted; corolla none; styles two, bifid; capsule bristly, four-valved, many-seeded. There is only one species, *viz.* T. laurifolia, a native of the woods of Guiana.

TRICHOCEPHALUS, in natural history, a genus of the Vermes Intestina class and order. Body round, elastic, and variously twisted; head or fore part much thicker, and furnished with a slender exsertile proboscis; tail or lower part long, capillary, and tapering to a point. There are six species enumerated, and named from the animals in which they are found: T. hominis inhabits the intestines of sickly children, generally the cœcum, and in considerable numbers; it is usually about two inches long, and in colour it resembles the ascarides. The head is obtuse, and furnished with a very slender proboscis, which it can eject or retract at pleasure; tail, or thinner part, twice as long as the thicker end, and terminating in a fine hair-like point. T. equi found in the intestines of the horse; there are others found in the intestines of the boar, fox, mouse, &c.

TRICHODA, in natural history, a genus of the Vermes Infusoria. Worm invisible, pellucid, hairy, or horned. There are seventy or eighty species in sections. A. hairy. B. furnished with cirri. C. horned.

TRICHOMANES, in botany, a genus of the Cryptogamia Filices class and order. Natural order of Filices or Ferns. Generic character: fructifications inserted into the margin of the frond, separate; in-

volucres urn shaped, undivided, opening outwards; columns extending beyond the involucres, like styles. There are twenty-seven species, chiefly natives of the West Indies.

TRICHOSANTHES, in botany, a genus of the Monoecia Syngenesia class and order. Natural order of Cucurbitaceæ. Essential character: calyx five-toothed; corolla five-parted; ciliate; male, filaments three; female, style trifid; pome oblong. There are seven species.

TRICOSTEMA, in botany, a genus of the Didynamia Gymnospermia class and order. Natural order of Verticillatæ or Labiatæ. Essential character: corolla, upper lip sickle shaped; stamina very long. There are three species.

TRIDAX, in botany, a genus of the Syngenesia Polygamia Superflua class and order. Natural order of Compositæ Oppositifoliæ. Corymbiferæ, Jussieu. Essential character: calyx imbricate, cylindrical; corollets of the ray three-parted; down many rayed, simple; receptacle chaffy. There is only one species, *viz.* T. procumbens.

TRIENS, in antiquity, a copper money of the value of one-third of an *as*, which on one side bore a Janus's head, and on the other a water-rat.

TRIENTALIS, in botany, a genus of the Heptandria Monogynia class and order. Natural order of Rotaceæ. Lysimachiæ, Jussieu. Essential character: calyx seven-leaved; corolla seven-parted, equal, flat; berry juiceless. There is but one species, *viz.* T. Europœa, chickweed winter green.

TRIFOLIUM, in botany, *trefoil*, a genus of the Diadelphia Decandria class and order. Natural order of Papilionaceæ or Leguminosæ. Essential character: flowers in a head; legume scarcely longer than the calyx; nectary opening, deciduous. There are fifty-one species. T. officinale or melilot, has naked racemous pods, dispermous, wrinkly, and acute, with an erect stalk. It grows in corn-fields, and by the way sides, but is not common. The stalk is erect, firm, striated, branched, and two or three feet high; the leaves ternate, smooth, obtusely oval, and serrated; the flowers are small, yellow, pendulous, and grow in long close spikes at the tops of the branches; the pod is very short, turgid, transversely wrinkled, pendulous, and contains either one or two seeds. The plant has a very peculiar strong scent, and disagreeable, bitter, acrid taste, but such, however, as is not disagreeable to cattle. The flowers are sweet scented. It communicates a loathsome flavour to wheat and other grain, so as to render it unfit for making bread. T. repens, white creeping trefoil, or Dutch clover, has a creeping stalk, its flower gathered into an umbellar head, and its pods tetraspermous. It is very common in fields and pastures. It is well known to be excellent fodder for cattle; and the leaves are a good rustic hygrometer, as they are always relaxed and flaccid in dry weather, but erect in moist or rainy. T. pratense, purple, or red clover, is distinguished by dense spikes, unequal corollas, by bearded stipulas, ascending stalks, and by the calyx having four equal teeth. The red clover is common in meadows and pastures, and is the species which is generally cultivated as food for cattle. It abounds in every part of Europe, in North America, and even in Siberia. It delights most in rich, moist, and sunny places, yet flourishes in those that are dry, barren, and shady. See Husbandry.

TRIGLA, the *gurnard*, in natural history, a genus of fishes of the order Thoracici. Generic character: head large, mailed, and marked with rough lines; eyes large; nostrils double: gill covers spiny; gill membrane seven-rayed; before the pectoral fins of most species there are articulate processes, somewhat like fingers. There are fourteen species. T. gurnardus, or the grey gurnard, varies in length from one to two feet; feeds on worms and insects; inhabits the seas of Europe, and is considered by many as excellent for the table, though generally not in high estimation. T. volitans, or the flying gurnard, is found in the Indian, Atlantic, and Mediterranean seas. It is about a foot in length, and its pectoral fins are of an extraordinary size, and great transparency. By these it is enabled to sustain short flights out of the water, when hardly pressed by its various enemies.

TRIGLOCHIN, in botany, *arrow grass*, a genus of the Hexandria Trigynia class and order Natural order of Tripetaloideæ. Junci, Jussieu. Essential character: calyx three-leaved; petals three, calyx form; style none; capsule opening at the base. There are three species.

TRIGONELLA, in botany, *fenu-greek*, a genus of the Diadelphia Decandria class and order. Natural order of Papilionaceæ or Leguminosæ. Essential character: banner and wings nearly equal, spreading in form of a three-petalled corolla. There are twelve species.

TRIGONIA, in botany, a genus of the Diadelphia Decandria class and order. Natural order of Malpighiæ, Jussieu. Essential character: calyx five-parted; petals five, unequal, uppermost foveolate at the base within; nectary, two scales at the base of the germ; filaments, some barren; capsule leguminose, three-cornered, three celled, three-valved. There are two species: *viz.* T. villosa, and T. lævis; both natives of South America.

TRIGONOMETRY. The business of this important science is to find the angles where the sides are given; and the sides of their respective ratios, when the angles are given; and to find sides and angles, when sides and angles are partly given. To effect this, it is necessary not only that the peripheries of circles, but also certain right lines in and about circles, be supposed divided into certain numbers of parts. The ancients, feeling the necessity of such a pre-division, portioned the circle into 360 equal parts, which they called degrees; each degree was again divided into 60 equal parts, called minutes; and each minute comprised 60 equal parts, called seconds. The moderns have improved upon this division by the addition of a nonius, or vernier, which may be carried to any extent, but is usually limited to decimating the seconds; noting each tenth part thereof. It would have been found a considerable convenience in mathematics, if the circle had been divided into centisimal parts, particularly in trigonometrical operations; thus making every quadrant to consist of 100 degrees, each degree of 100 minutes, and each minute of 100 seconds: there can, indeed, be no doubt but all the arithmetical calculations relating to the periphery, as well as to the secants, sines, tangents, radii, chords, and complements, would by this reformation have been simplified.

We shall be brief on this head, because it would require more space than could be allotted to any one branch of science, were we to follow the whole extent of trigonometry in this place. The following definitions will be found useful: 1. The complement of an arc is the difference thereof from a quadrant; thus, if an arc measures 60°, the complement is 30°. 2. A chord, or subtense, is a right line drawn from one to the other end of an arc. 3. The sine, or right sine, of an arc, is a perpendicular falling from one end of an arc to the radius drawn, at right angles thereto, towards the other end of the arc. Hence it is clear that an arc of 60° must have its secant, its radius, and its chord, all of the same length, forming an equilateral triangle. The secant and radius both proceed from the centre; but all sines are parallel to a vertical line passing through the centre, and invariably fall upon a diameter, drawn perpendicular to that right line. See DIALLING, GEOMETRY, and MATHEMATICAL *instruments;* under which various explanations will be found, whereby the student may perceive the necessity for such reference.

The solution of the several cases in plane trigonometry depend upon four propositions, called axioms, which cannot be too perfectly understood, and ought ever to be adverted to.

Axiom I. In any right-lined plane triangle, if the hypothenuse (or longest side) be made the radius of a circle, the other two sides, or legs, will be the sines of their opposite angles; but if either of the legs, including the right angle, be made radius, the other leg becomes the tangent of its opposite angle, and the hypothenuse the secant of the same angle. For in the triangle A B C, (fig. 21. Plate XV. Trigonometry,) let A B be made the radius of a circle; and with one foot of the compasses on A or B describe a circle: it is plain that the leg B C will be the sine of the angle A, and A C the sine of the angle B: but if A C becomes radius, B C will be the tangent to the angle A, and B A the second thereto. Again, by making B C radius, A C will be tangent, and A B the secant of the angle B. Hence it is plain that the different sides take their names according to that side which is made radius.

Remark, that to find a side, any side may be made radius: then say, as the name of the side given is to the name of the side required; so is the side given to the side required. But to find an angle, one of the given sides must be made radius: then, as the side made radius is to the other side; so is the name of the first side (which is always radius) to the name of the second side; which fourth proportional must be found among the sines, or tangents, &c. to be determined by the side made radius: against it is the required angle. In a right-angled triangle you must always have two sides, or the angles and one side given, to find the rest.

Axiom II. In all plane triangles, the sides are in direct proportion to the sines of their opposite angles. Thus, "if two angles and one side be given, to find ei-

ther of the other legs." In fig. 22, the angle B C D is 101° 25′, the angle C B D is 44° 42′, and the given leg B C is equal to 76 of the scale assumed: to find the sides CD and BD.

To find D C

As the sine angle D 101° 25′ .	9.99132
Is to the side B C 76	1.88081
So is sine angle B 44° 42′ . .	9.84720
	11.72801
	9.99132
To the side D C 54.53 . . .	1.73669

The foregoing is worked by logarithms, thus: add the logarithm of the second and third terms together, then deduct the logarithm of the first term, and the remainder is the logarithm of the fourth term, or number sought. When an angle is greater than 90°, the sine, tangent, and secant of the supplement, (*i. e.* of the number of degrees wanting of 180°,) are to be used.

"Two sides, and an angle opposite to one of them, being given, to find the other opposite angle, and the third side, fig. 23." The side B C 106, D B 65 miles, and the angle B C D 31° 49′ given, to find the angle B D C obtuse, and the side CD.

To find D.

As the sine B D 65	1.81291
Is to the angle C 31° 49′ . . .	9.72198
So is the side B C 106 . . .	2.02531
	11.74729
	1.81291
To sine angle D 120° 43′ . .	9.93438

To find D C.

As sine angle C 31° 49′ . . .	9.72198
Is to the sine B D 65	1.81291
So is sine angle B 27.28 . .	9.66392
	11.47683
	9.72198
To the sine D C 56.88 . . .	1.75485

Axiom III. In every plane triangle it will be as the sum of any two sides is to their difference; so is the tangent of half the sum of the angles opposite there, to the tangent of half their difference. Which half difference, being added to half the sum of the angles, gives the greater; but if subtracted, the remainder will be the lesser angle.

"Two sides, and their contained angle given, to find either of the other angles, and the third side, fig 24." The side B C 109, B D 76 leagues, and the angle C B D 101° 30′ being given, to find the angle B D C, or B C D, and the side C D.

The side B C . .	109 . . .		109 . . .	180° 0′	
B D . .	76 . . .		76 . . .	101° 30′	
Sum	185	Diff. .	33 . . .	78° 30′	sum of the two angles at D and C.
			Half .	39° 15′	

To find the angles D *and* C.

As the sum of the sides B C and B D = 185	2.26717
Is to the difference 33	1.51851
So is the tangent of half the sum of angles C and D 39° 15′	9.91224
	11.43075
	2.26717
To the tangent of half the difference of the angles C and D 8° 17′ .	9.16358

To half the sum of the angles D and C	39° 15′
Add half the difference of the angles C and D	8° 17′
Gives the greater angle D	47° 32′
But if subtracted (from 39° 15′) gives the lesser angle	30° 58′

Having the two angles, the side is found according to Axiom II: for it will be,

To find D C.

As the sine angle D 47° 32′	9.86786
Is to sine B C 109	2.03743
So is sine angle B 101° 30′	9.99116
	12.02862
	9.86786
To the side D C required 144.8	2.16076

Axiom IV. In any plane triangle, as the base, or greater side, is to the sum of the other two sides; so is the difference of the sides to the difference of the segments of the base, made by a perpendicular let fall from the angle opposite to the base: and if half the difference of the segments be added to half their sum, it will give the greater segment; but if subtracted, the remainder will be the lesser segment. The triangle being thus cut, becomes two right angled triangles; the hypothenuses and bases of which are given to find the angles by Axiom I.

Three sides given to find the angles.

The side B C 105, B D 85, and C D 50 miles, being given to find the angles B D C B C D, and C B D, fig. 5.

	B D = 85
	C D = 50
The sum of the two shortest sides	135
The difference of them	35

The proportions will be

As the side B C	105 —	2.02119 —	52½ the half of great side.
Is to the sum of the sides BD and DC	135 —	2.13033 —	22½ half diff. of segment.
So is the diff. of the sides BD and DC	35 —	1.54417	75 the greatest segment.
		3.67440	
		2.02119	30 the lesser segment.
Difference of the segment of the base, or great side		451.65321	

Having divided the right-angled triangle into two right-angled triangles, the hypothenuses and bases of which are given, to find the angles by Gunter. 1. The extent from 105 to 135 will reach from 35 to 45 on the line of sines. 2. The extent from 85 to 75, on the line of numbers, will reach from radius to 61° 56′, the angle B D A on the line of sines. 3. The extent from 50 to 30, on the line of numbers, will reach from radius to angle A D C 36° 53′, on the line of sines.

TRIGONOMETRY, *spherical,* relates to triangles, or figures which are reducible to

triangles, whose sides are segments of circles. Thus if we describe a triangle on any spherical body, say a globe, it is evident that all the sides must be composed of curved lines; and it is the same in the case of a series of circles, or of orbits, intersecting each other. When two equal circles intersect, they will give a parabolic spindle; more or less acute, according as the centres of the two circles may be more or less distant. When three circles mutually intersect, there will be formed a great variety of spherical triangles, of which the areas and the properties could not be ascertained by plane-trigonometry, but come under consideration as parts of spherical surfaces. The following definitions should be clearly understood; they are simple in the extreme, but highly important: 1st. The poles of a sphere are two points in the superficies of the sphere, that are the extreme of the axis. 2d. The pole of a circle in a sphere is a point in the superficies of the sphere, from which all right lines that are drawn to the circumference of the circle are equal to one another. 3d. A great circle in a sphere, is that whose plane passes through the centre of the sphere; and whose centre is the same as that of the sphere. 4th. A spherical triangle is a figure comprehended under the arcs of three great circles in a sphere. 5th. A spherical angle is that which, in the superficies of the sphere, is contained under two arcs of great circles; and this angle is equal to the inclinations of the planes of the said circles. It is particularly to be held in mind, that although we can, upon any actual sphere, describe triangles at pleasure, which may nearly embrace the whole circumference, yet that such cannot be laid down, so as to be represented on paper; for every side of a spherical triangle is less than a semi-circle.

With respect to spherical triangles, the learner may generally entertain a correct opinion of their value, if he considers that every arc or segment of a circle may have a chord drawn from one to the other extremity; and that the triangle which can be contained within such arc or segment, taking the chord for a hypothenuse, will determine how much of that circle has been cut off, and is included between the extremes of the segment. It is utterly impossible to produce any two measurable segments taken from two different circles, which, having chords of equal length, will contain the same angle. A semicircle, having the diameter for its chord, will give a right angle; for if to any point within that semicircle two lines be drawn, from the ends of the chord respectively, their union at such assumed point will form a right angle. In proportion as the chord is less than a diameter, so must the segment be a less part of the whole circle, and the angle contained therein will be more acute. Spherical triangles may be acute, right-angled, or obtuse, the same as on plane-trigonometry. In all right-angled spherical triangles, the sign of the hypothenuse : radius :: sine of a leg : sine of its opposite angle. And the sine of the leg : radius :: tangent of the other leg : tangent of its opposite angle. In any right-angled spherical triangle, A B C (fig. 25,) it will be as radius is to the co-sine of one leg, so is the co-sine of the other leg to the co-sine of the hypothenuse. Hence, if two right-angled spherical triangles, A B C, C B D (fig. 26,) have the same perpendicular, BC, the co-sines of their hypothenuses will be to each other directly as the co-sines of their bases. In any spherical triangle it will be, as radius is to the sine of either angle, so is the co-sine of the adjacent leg to the co-sine of the opposite angle. Hence, in right-angled spherical triangles, having the same perpendicular, the co-sines of the angles at the base will be to each other, directly, as the sines of the vertical angles. In any right-angled spherical triangle it will be, as radius is to the co-sine of the hypothenuse, so is the tangent of either angle to the co-tangent of the other angle. As the sum of the sines of two unequal arches is to their difference, so is the tangent of half the sum of those arches to the tangent of half their difference: and as the sum of their co-sines is to their difference, so is the co-tangent of half the sum of the arches to the tangent of half the difference of the same arches. In any spherical triangle, A B C (fig. 27,) it will be, as the co-tangent of half the sum of the angles at the base is to the tangent of half their difference, so is the tangent of half the verticle angle to the tangent of the angle which the perpendicular C D makes with the line C F, bisecting the vertical angle.

The following propositions and remarks concerning spherical triangles, will render their calculation perspicuous and free from ambiguity. 1st. A spherical triangle is equilateral, isocelar, or scalene, according as it has its three angles all equal, or two of them equal, or all three unequal. 2d. The greatest side is always opposite the greatest angle, and the smallest side opposite the smallest angle. 3d. Any two

sides, taken together, are greater than the third. 4th. If the three angles are all acute, or all right, or all obtuse, the three sides will be, accordingly, all less than 90°, or 90°, or greater than 90°. 5th. If from the three angles A, B, C, of a triangle A B C (fig. 23), as poles, there be described on the surface of the sphere, three arches of a great circle DE, DF, FE forming by their intersections a new spherical triangle DEF; each side of the new triangle will be the supplement of the angle at its pole; and each angle of the same triangle will be the supplement of the side opposite to it in the triangle ABC. 6th. In any triangle A B C (fig. 29), or A *b* C, right-angled in A: 1st, The angles at the hypothenuse are always of the same kind as their opposite sides. 2dly. The hypothenuse is greater or lesser than a quadrant, according as the sides, including the right angle, are of the same, or different kinds; that is to say, according as the same sides, are either both acute, or both obtuse: or, as one is acute, and the other obtuse. And *vice versa:* 1st. The sides including the right angles, are always of the same kind as their opposite angles. 2dly, The sides, including the right angles, will be of the same, or different kinds, according as the hypothenuse is less, or more, than 90°; but, one at least of them will be of 90°, if the hypothenuse is so.

Considering it impossible to give a popular idea of this highly important branch of mathematics, in any brief form, we must refer those readers, who wish to become proficients therein, to the various excellent treatises published on that subject; particularly those by Simpson, Bonycastle, Payne, &c.

TRIGUERA, in botany, a genus of the Pentandria Monogynia class and order. Natural order of Luridæ. Solaneæ, Jussieu. Essential character: corolla bell-shaped, with an unequal border; nectary short, five toothed, surrounding the germ; filaments inserted into the nectary; berry four celled, with two seeds in each cell. There are two species; *viz.* T. ambrosiaca, and T. inodora: these are both annual plants, and natives of Andalusia in Spain.

TRILIX, in botany, a genus of the Polyandria Monogynia class and order. Essential character: calyx three-leaved: corolla three-petalled; berry five-celled, many seeded. There is only one species; *viz.* T. lutea, a native of Carthagena, in America.

TRILLION, in arithmetic, a billion of billions. See ARITHMETIC, NUMERATION.

TRILLIUM, in botany, a genus of the Hexandria Trigynia class and order. Natural order of Sarmentaceæ. Asparagi, Jussieu. Essential character: calyx three-leaved: corolla three petalled; berry three-celled. There are three species.

TRIM *of a ship*, her best posture, proportion of ballast, and hanging of her masts, &c. for sailing. To find the trim of a ship, is to find the best way of making her sail swiftly, or how she will sail best. This is done by easing of her masts and shrouds; some ships sailing much better when they are slack, than when they are taught, or fast; but this depends much upon experience and judgment, and the several trials and observations which the the commander and other officers may make aboard.

TRIMMERS, in architecture, pieces of timber framed at right angles to the joints, against the ways for chimneys, and well-holes for stairs.

TRINGA, the *sand-piper*, in natural history, a genus of birds of the order Grallæ. Generic character: bill round, straight, slender, and about the length of the head; nostrils small and linear: tongue slender; toes very slightly, if at all, connected at the base by a membrane; hind-toe weak. There are thirty-seven species, of which the following are the principal:

T. pugnax, or the ruff, is twelve inches long. The male is distinguished by a ruff, differing in colour on almost every bird, composed of long feathers, standing out in a peculiar manner, and constituting an appearance somewhat resembling the fashionable neck ruff of the age of Queen Elizabeth. These feathers are not acquired till the second year, and continue only during the season of spring; after which, also, the caruncles which previously rise on the face of the male shrink back and disappear. The males of these birds are thought far more numerous than the females. Frequent conflicts between the former are occasioned from this circumstance; and in the commencement of spring, a male sand-piper is said to take his station near some water, and run round a particular spot such a number of times, that at length he bares a circular path upon the herbage. On the appearance of a female near this spot, the males engage in the most animated and ferocious contests, and occupied solely by the idea of triumphing over their rivals, they suffer

themselves to be taken by the net of the fowler, who avails himself of these opportunities for their destruction. In England they are migratory, and are found frequently in Lincolnshire and the Isle of Ely, where after being taken, they are fed for sale, till they at length become nearly a mass of marrowy substance, and are sent to the markets of the metropolis.

T. vanellus, or the lapwing, is thirteen inches long, and of the weight of eight ounces. It remains in England the whole year; lays its eggs on the ground; and the female bird exercises various arts to attract the attention of mischievous and depredating school boys from the discovery of her nest, and is said, with this view even to pretend lameness, to direct their pursuit to herself. In winter these birds appear in flocks of several hundreds, and are caught in great numbers, being highly esteemed for food. They live chiefly upon worms, which appear to constitute their delicious banquet, and are sometimes familiarised, and kept in gardens to clear them of slugs and worms, in search for which, both in the morning and evening, they are extremely assiduous.

T. hypoleucos, or the common sand-piper, breeds in England, but soon withdraws after the summer. It is about eight inches long, and is distinguished by its piping note. It is found in France and Siberia.

The T. canutus is about ten inches in length, and weighs four ounces, and frequents the coasts of Lincolnshire, England, where it is taken in considerable numbers, and fattened for the London market. By some these birds are preferred to the ruff.

TRINITY *house*, a kind of college belonging to a company or corporation of seamen, who, by the King's charter, have power to take cognizance of those persons who destroy sea-marks, and to get reparation of such damages; and to take care of other things belonging to navigation. At present, many in the first rank of society are members of that community. The master, wardens, and assistants of the Trinity House, may set up beacons, and marks for the sea, in such places, near the coasts or forelands, as to them shall seem meet. By a statute of Queen Elizabeth, no steeple, trees, or other things standing as sea marks, shall be taken away or cut down, upon pain that every person guilty of such offence, shall forfeit 100*l.* and if the person offending be not possessed of the value, he shall be deemed convict of outlawry.

TRINOMIAL, or TRINOMIAL *root*, in mathematics, is a root consisting of three parts, connected together by the signs + or −, as $x + y + z$, or $a + b - e$. See BINOMIAL and ROOT.

TRIO, in music, a part of a concert wherein three persons sing; or more properly a musical composition consisting of three parts. Trios are the finest kinds of composition, and these are what please most in concerts.

TRIOPTERIS, in botany, a genus of the Decandria Trigynia class and order. Natural order of Trihilatæ. Malpighiæ, Jussieu. Essential character: calyx five-parted, with two honey pores at the base on the outside; petals roundish, clawed filaments cohering at the base; capsules three, one-seeded, three or four-winged. There are eight species.

TRIOSTEUM, in botany, a genus of the Pentandria Monogynia class and order. Natural order of Aggregatæ. Caprifolia, Jussieu. Essential character: calyx length of the corolla; corolla one-petalled, almost equal; berry three-celled, inferior; seeds solitary. There are three species.

TRIPARTITE, something divided into three parts, or made by three parties, as indenture tripartite.

TRIPLE *time*, in music, a time consisting of three measures in a bar; the two first of which are beat with the hand or foot down, and the third marked by its elevation.

TRIPLARIS, in botany, a genus of the Triandria Trigynia class and order. Natural order of Polygoneæ, Jussieu. Essential character: calyx very large, three, or six-parted; corolla three-petalled, or none: nut three-sided, within the ovate base of the calyx. There are two species, *viz.* T. Americana, and T. ramiflora.

TRIPLICATE *ratio*, the ratio which cubes bear to one another. This ratio is to be distinguished from triple ratio, and may be thus conceived: in the geometrical proportions 2, 4, 8, 16, 32, as the ratio of the first term (2) is to the third (8) duplicate of that of the first to the second, or of the second to the third, so the ratio of the first to the fourth is said to be triplicate of the ratio of the first to the second, or of that of the second to the third, or of that of the third to the fourth, as being compounded of three equal ratios. See RATIO.

TRIPOLI, in mineralogy, a species of the Clay genus, is of a greyish colour: it occurs massive, is soft and friable, feels meagre, and does not adhere to the tongue. It occurs in veins and beds in

floëtz rocks, and perhaps in alluvial land. It is found in beds in the coal works of Thuringia: in Derbyshire, it occurs in veins: in Tripoli, whence its name is derived, it also forms veins. It is also found in Russia, Westphalia, Flanders, Hessia, Bohemia, and Switzerland. When reduced to powder, it is employed for polishing metals, marbles, and other minerals, and likewise for polishing glass. Formerly it was supposed to be a volcanic production, which has been long since disproved, and it appears to be an extremely fine mixture of clay and sand.

TRIPPANE, in mineralogy, is of an apple-green, or greenish white It occurs in mass, is moderately hard, and easily frangible. Specific gravity is 3.21. Before the blow-pipe it becomes yellow, and splits into thin plates, and then melts into a thin transparent glass. It has hitherto been found in Sweden, in veins of quartz and mica.

TRIPPING, in heraldry, denotes the quick motion of all sorts of deer, and of some other creatures, represented with one foot as it were on a trot.

TRIPSACUM, in botany, a genus of the Monoecia Triandria class and order. Natural order of Gramina, Gramineæ, or Grasses. Essential character: male, calyx glume four-flowered; corolla glume membranaceous: female, calyx glume with perforated sinuses; corolla glume two-valved; styles two; seed one. There are two species, *viz.* T. dactyloides, and T. hermaphroditum.

TRISECTION, or TRISSECTION, the dividing a thing into three. The term is chiefly used in geometry, for the division of an angle into three equal parts. The trisection of an angle geometrically, is one of those great problems, whose solution has been so much sought by mathematicians for these two thousand years, being, in this respect, on a footing with the quadrature of the circle, and the duplicature of the cube angle.

TRISPAST, in mechanics, a machine with three pullies, or an assemblage of three pullies for raising of great weights.

TRITICUM, in botany, *wheat*, a genus of the Triandria Digynia class and order. Natural order of Gramina, Gramineæ, or Grasses. Essential character: calyx two-valved, solitary, subtriflorous; corolla blunt, with a point. There are nineteen species. T. æstivum, or spring wheat, has four flowers in a calyx, three of which mostly bear grain. The calyces stand pretty distant from each other, on both sides a flat smooth receptacle. The leaves of the calyx are keel-shaped, smooth, and they terminate with a short arista. The glumes of the flowers are smooth and bellying, and the outer leaf of three of the glumes in every calyx is terminated by a long arista, but the three inner ones are beardless. The grain is rather longer and thinner than the common wheat. It is supposed to be a native of some part of Tartary. The farmers call it spring-wheat, because it will come to the sickle with the common wheat, though it should be sown in February or March. T. hybernum, winter or common wheat, has also four flowers in a calyx, three of which are mostly productive. The calyces stand on each side a smooth flat receptacle, as in the former species, but they are not quite so far asunder. The leaves of the calyx are bellying, and so smooth that they appear as if polished, but they have no arista. The glumes of the flowers too are smooth, and the outer ones, near the top of the spike, are often tipped with short aristæ. The grain is rather plumper than the former, and is the sort most generally sown in England; whence the name of common wheat. T. turgidum, thick-spiked or cone-wheat, is easily distinguished from either of the former; for though it has four flowers in a calyx, after the manner of them, yet the whole calyx, and the edges of the glumes, are covered with soft hairs. The calyces, too, stand thicker on the receptacle, and make the spike appear more turgid. Some of the outer glumes, near the top of the spike, are terminated by short aristæ, like those of the common wheat. The grain is shorter, plumper, and more convex on the back than either of the former species. Its varieties are numerous, and have various appellations in different counties, owing to the great affinity of several of them.

TRITOMA, in natural history, a genus of insects of the order Coleoptera. Antennæ clavate, the club perfoliate; lip emarginate; anterior feelers hatchet-shaped; shells as long as the body. There are ten species, found in different parts of the world. T. bipustalata is black; shells with a lateral scarlet spot. It inhabits England, and is found on tree fungi. The glabra is found in Sweden, under the bark of trees.

TRITON, in natural history, a genus of the Vermes Mollusca class and order. Body oblong; mouth with an involute spiral proboscis; tentacula twelve, six

on each side, divided nearly to the base, the hind ones cheliferous. T. littoreus, inhabits Italy, in cavities of sub-marine rocks, and may be seen in various species of Lepas, particularly the anatefera. It is fully described in the "Philosophical Transactions of London," vol. 50.

TRITURATION, in pharmacy, the act of reducing a solid body into a subtle powder; called also levigation, and pulverization.

TRIUMFETTA, in botany, a genus of the Dodecandria Monogynia class and order. Natural order of Columniferæ. Tiliaceæ, Jussieu. Essential character: calyx five-leaved; corolla five-petalled: capsule hispid, opening in four parts. There are eleven species.

TRIXIS, in botany, a genus of the Syngenesia Polygamia Necessaria class and order. Natural order of Compositæ Oppositifoliæ. Corymbiferæ, Jussieu. Essential character: corollets of the ray trifid; seeds hairy at the tip, without any down; receptacle chaffy. There are three species, all natives of the West Indies.

TROCHAIC *verse*, in the Latin poetry, a kind of verse, so called, because the trochees chiefly prevail, as the iambus does in the iambic. It generally consists of seven feet and a syllable; the odd feet, for the most part, consist of troches, though a trybraches is sometimes admitted, except in the seventh foot: these two feet are likewise used in the other places, as is also the spondæus, dactylus, and anapæstus. The following is an example.

1	2	3	4	5	6
Solus	*aut rex*	*aut po*	*eta*	*non quot*	*annis*

7	½
nasci	*tur.*

TROCHE, in pharmacy, a sort of medicine, made of glutinous substances into little cakes, and afterwards exsiccated.

TROCHILUS, the *humming bird*, in natural history, a genus of birds of the order Picæ. Generic character: bill slender and weak; nostrils minute; tongue long, constituted of two united cylindric tubes, and missile; tail of ten feathers; legs weak. The bills of some are curved, and of others strait, which forms the grand division of the genus. There are sixty species enumerated by Latham, and Gmelin has sixty-five. The birds of this genus are the smallest of all birds. They subsist many of them on the juices of flowers, which they extract like bees while on the wing, fluttering over their delicate repast, and making a considerable humming sound, from which they derive their designation. They are gregarious, and build their nests with great neatness and elegance, lining them with the softest materials they can possibly procure.

T. colubris, or the red-throated humming bird, is rather more than three inches long, and is frequent in various parts of North America. Its plumage is highly splendid and varying; it subsists on the nectar of flowers, particularly those of a long tube, like the convolvulus or tulip. They will suffer themselves to be approached very nearly; but on observing an effort to seize them, dart off with the rapidity of an arrow. A flower is frequently the subject of bitter conflict between two of these birds; and they will often enter an open window, and after a short contest retire. They sometimes soar perpendicularly to a considerable height, with a violent scream. If a flower which they enter furnishes them with no supply, they pluck it, as it were in punishment and revenge, from its stalk. They have been kept alive in cages for several weeks, but soon perish for want of their usual food, for which no adequate substitute has yet been found Latham, however, mentions the curious circumstance of their being preserved alive by Captain Davies for four months, by the expedient of imitating tubular flowers with paper, appropriately painted, and filling the bottom of the tubes with sugar and water as often as they were emptied. They then took their nourishment in the same manner as when unconfined, and soon appeared familiarized and happy. They lived, however, only four months. These birds generally build on the middle of the branch of a tree, and lay two eggs in an extremely small and admirably constructed nest. This is the only species of the genus known to exist in the United States.

T. minimus. This is the smallest of all the species, and is said, when just killed, to weigh no more than twenty grains. Its total length is an inch and a quarter. It is found in the West Indies and South America, and is exceeded both in weight and magnitude by several species of bees.

For the amethystine humming-bird, see Aves, Plate XIV. fig. 3.

TROCHLEA, one of the mechanical powers, usually called a pulley. See Mechanics.

TROCHOID, in geometry, a curve

more generally known by the name of cycloid. See CYCLOID.

TROCHUS, in natural history, a genus of the Vermes Testacea. Animal a limax; shell univalve, spiral, more or less conic; aperture somewhat angular or rounded, the upper side transverse and contracted, pillar placed obliquely. There are about 150 species, divided into sections. A. Erect, with the pillar perforated. B. Imperforate, erect, the umbilicus, or navel, closed. C. Tapering, with an exserted pillar, and falling on the side when placed on the base. Of these we may notice T. telescopium: shell imperforate, striate, with a spiral pillar. It inhabits the Indian ocean, and is about four inches long; the shell is tapering, like a telescope when drawn out; brown liver colour, or blackish, the first whorl generally barred with white; pillar a little prominent, with a tooth or plait in the middle; whorls flattish.

TROGON, the *curucui*, in natural history, a genus of birds of the order Picæ. Generic character: bill short, thick, and convex, serrated at the edges; nostrils covered with stiff bristles; toes, two before and two behind; tail of twelve feathers. Birds of this genus chiefly inhabit South America, live solitary in moist places, and in pathless overgrown woods; make short flights, and subsist principally on insects. There are seven species.

T. curucui, the red-bellied curucui, is an inhabitant of Cayenne, and is about as large as a magpie. These birds are not gregarious, and are never seen but alone, or in pairs. They lay their eggs in the holes of trees upon the rotten dust, preparing no nest. The male is mute, unless in spring, and then has a plaintive and monotonous note. The young, when first hatched, are bare of feathers, and have a head very disproportionately large to the body; they are fed with insects and caterpillars till able to provide for themselves, and then left by their parents, who return to their sequestered haunts, and in September are engaged with a second brood. When confined, they refuse all food, and, consequently, soon perish.

TROLLIUS, in botany, *globe flower*, a genus of the Polyandria Polygynia class and order. Natural order of Multisiliquæ. Ranunculaceæ, Jussieu. Essential character: calyx none; petals about fourteen; capsules numerous, ovate, many-seeded. There are two species, *viz*. T. Europæus, European globe flower, and T. Asiaticus, Asiatic globe flower.

TRONAGE, the mayor and commonalty of the city of London, are ordained keepers of the beams and weights for weighing merchants' commodities, with power to assign clerks, porters, &c. of the great beam and balance; which weighing of goods and wares is called tronage.

TROPÆOLUM, in botany, *Indian cress*, a genus of the Octandria Monogynia class and order. Natural order of Trihilatæ. Gerania, Jussieu. Essential character: calyx one-leafed, with a spur; petals four, unequal; nuts three, coriaceous. There are five species.

TROPE, in rhetoric, a kind of figure of speech, whereby a word is removed from its first and natural signification, and applied with advantage to another thing, which it does not originally mean; but only stands for it, as it has a relation to, or connection with it: as in this sentence, *God is my rock*. Here the trope lies in the word *rock*, which being firm and immoveable, excites in our minds the notion of God's unfailing power, and the steady support which good men receive from their dependence upon him.

TROPHIS, in botany, a genus of the Dioecia Tetrandria class and order. Natural order of Calycifloræ. Essential character: male, calyx none; corolla four-petalled: female, calyx none; corolla none; style two-parted; berry-one seeded. There is but one species, *viz*. T. Americana, the ramoon tree, which is a native of Jamaica and other islands in the West Indies in dry exposed situations.

TROPHY, among the ancients, a pile or heap of arms of a vanquished enemy, raised by the conqueror in the most eminent part of the field of battle. The trophies were usually dedicated to some of the gods, especially Jupiter. The name of the deity to whom they were inscribed, was generally mentioned, as was that also of the conqueror. The spoils were at first hung upon the trunk of a tree; but instead of trees, succeeding ages erected pillars of stone, or brass, to continue the memory of their victories. To demolish a trophy was looked upon as a kind of sacrilege, because they were all consecrated to some deity.

TROPICS, in astronomy and geography, are two circles supposed to be drawn on each side of the equinoctial, and parallel thereto. That on the north-side of the line is called the tropic of cancer, and the southern tropic has the name of capricorn, as passing through the beginning of those signs. They are distant from the equinoctial 23° 29′. Two circles

drawn at the same distance from the equator on the terrestrial globe, have the same names in geography, and they include that space or part of the sphere, which is called the torrid zone, because the sun is, at one time or other, perpendicular over every part of that zone, and extremely torrifies or heats it.

TROVER is the remedy prescribed by the law, where any person is in possession of the property of another, which he unlawfully detains. Previously to commencing this action, a demand of the property so detained must be made in writing, by some person properly authorised by the owner of the property; and upon refusal to restore it, the law presumes an unlawful conversion, and the party is entitled to this action, and will recover damages to the value of the property detained. In trover, the smallest damages will carry costs. A similar action may be brought for the unlawful detention of any property, on which the specific articles, so detained, may be recovered, which is called detinue; but as the articles detained must be precisely stated in the declaration, and it is attended with some difficulty, this action is very seldom brought.

TROY *weight*, in commerce. See Weight.

Troy weight, formerly called Trone weight, is supposed to be taken from a weight of the same name in France, which was taken from the name of the town of Troyes. The original of all weights used in England, was a grain of wheat, taken out of the middle of the ear, and, when well dried, thirty-two of them were to make one penny-weight: twenty penny-weights one ounce: and twelve ounces one pound. Afterwards it was thought sufficient to divide the penny-weight into twenty-four equal parts, called grains, which is the least weight now in common use.

TRUCE, in the art of war, denotes a suspension of arms, or a cessation of hostilities between two armies, in order to settle articles of peace, bury the dead, or the like.

TRUCKS, among gunners, round pieces of wood, in form of wheels, fixed on the axle-trees of carriages; to move the ordnance at sea, and sometimes also at land.

TRUFFLES, in natural history, a kind of subterraneous vegetable production, not unlike mushrooms, being a genus of fungi, which grows under the surface of the earth.

TRUMPET, in music. See Musical *instruments*.

Trumpet, *speaking*, is a tube of considerable length, *viz.* from 6 feet to 12, and even more, used for speaking with to make the voice heard to a greater distance. In a trumpet of this kind the sound in one direction is supposed to be increased, not so much by its being prevented from spreading all round, as by the reflection from the sides of the trumpet. The figure best suited for the speaking trumpet is that which is generated by the rotation of a parabola, about a line parallel to the axis. The trumpet used at sea is represented by fig. 10. Plate XVI. Miscel. It is an hollow instrument of copper, or of tinned iron plates. It is open at both ends, and the narrow end, A is shaped so as to go round the speaker's mouth, and to leave the lips at liberty within it. The edge of this narrow end, A is generally covered with leather or cloth, in order that it may more effectually prevent the passage of any air between the trumpet and the face of the speaker. The words which are spoken through a speaking trumpet may be heard much further and louder, but not so distinctly, as without the trumpet. A speaking trumpet has been applied to the mouth of a gun or pistol, by which means the explosion has been rendered audible at a vast distance. Such contrivances it has been thought might be used as signals in certain cases.

Trumpet, *hearing*, is an instrument to assist the hearing of persons who are deaf. Instruments of this kind are formed of tubes, with a wide mouth, and terminating in a small canal, which is applied to the ear. The form of these instruments evidently shows how they conduce to assist the hearing, for the greater quantity of the weak and languid pulses of the air being received and collected by the large end of the tube, are reflected to the small end, where they are collected and condensed; thence entering the ear in this condensed state, they strike the tympanum with a greater force than they could naturally have done from the ear alone. Hence it appears, that a speaking trumpet may be applied to the purpose of a hearing trumpet, by turning the wide end towards the sound, and the narrow end to the ear.

TRUNCATED, in general, is an appellation given to such things as have, or seem to have, their points cut off: thus we say, a truncated cone, pyramid, leaf, &c.

TRUNCHEON, a short staff, or battoon, used by kings, generals, and great officers, as a mark of their command.

TRUNDLE, a sort of carriage with low wheels, whereon heavy and cumbersome burdens are drawn.

TRUNNIONS, or TRUNIONS *of a piece of ordnance*, are those knobs or bunches of the gun's metal, which bear her up on the cheeks of the carriage: and hence the trunnion-ring is the ring about a cannon, next before the trunnions.

TRUSS, a bundle, or certain quantity of hay, straw, &c. A truss of hay is to contain fifty-six pounds, or half an hundred weight; thirty-six trusses make a load. In June and August the truss is to weigh sixty pounds, on forfeiture of eighteen shillings per truss.

TRUSS, in naval affairs, a machine employed to pull a lower yard close to its mast, and retain it firmly in that position: it is rarely employed except in flying top gallant sails. It is a ring or traveller which encircles the mast, and has a rope fastened to its after part, leading downward to the top or decks; by means of which the truss may be straitened or slackened at pleasure.

TRUSS is also used for a sort of bandage or ligature, made of steel, or the like matter, wherewith to keep up the parts, in those who have hernias, or ruptures.

TRUST, is a right to receive profits of land, and to dispose of the land in equity; and one holding the possession, and disposing thereof at his will and pleasure, are signs of trust. A trust is but a new name given to an use, and invented to evade the statute of uses. By statute 29 Charles II. c. 3, all declaration or creation of trusts shall be manifested by some writing signed by the party, or by his last will in writing, or else shall be void. And by section 9 of the same act, assignments of trusts shall be in writing, signed by the party assigning the same, or by his last will, or else shall be of no effect.

By 29 Charles II. all declarations of trusts were to be made in writing: but in the said act there is a saving with regard to trusts resulting by implication of law, which are left on the footing whereon they stood before the act; now, a bare declaration by parol before the act would prevent any resulting trust.

If a man purchase lands in another's name, and pay the money, it will be a trust for him that paid the money, though there be no deed made declaring the trust thereof; for the statute of frauds and perjuries extends not to trusts raised by operations of law.

TUB, *match*, in naval affairs; the half of a cask, having notches sawn in its edges, in which the lighted matches are placed during action, the bottom being covered with water to extinguish any sparks which may fall from the match.

TUBE, in general, pipe, conduit, or canal; a cylinder hollow withinside, either of lead, iron, wood, glass, or other matter, for the air, or some other fluid, to have a free passage, or conveyance, through. Small silver or leaden tubes are frequently used, by surgeons, to draw off blood, matter, or water, from the different parts of the body: they are made of various sizes and shapes.

TUBE, in astronomy, is sometimes used for a telescope, or more properly, for that part thereof into which the lenses are fitted, and by which they are directed and used.

We have now certain articles in domestic use, as toasting-forks, &c. made on the principle of telescope tubes.

TUBULARIA, in natural history, a genus of the Vermes Zoophyta class and order: Stem tubular, simple or branched, fixed by the base; animal proceeding from the end of the tube, and having its head crested with tentacula. Twenty-six species have been enumerated. T. magnifica: tube simple, whitish; tentacula very numerous, variegated with red and white. It is found in the West Indies, adhering to rocks; and is by far the largest and most splendid of its genus: like the rest of its tribe, it has the power of withdrawing its tentacula within the tube, and the tube within the rock on which it resides. It connects, as it were, the genera tubularia and amphitrite, having the annulated wrinkled tube of the one, and the retractile tentaculated body of the other. T. fistulosa inhabits the European, Mediterranean, and Atlantic Seas; about three inches long, and as thick as common packthread.

TUCK *of a ship*, the trussing or gathering up the quarter under water; which if she lie deep, makes her leave a broad, or, as they call it, fat quarter, and hinders her steering, by keeping the water from passing swiftly to her rudder; and if this trussing lie too high above the water, she will want bearing for her works behind, unless her quarter be very well laid out.

TUFA, in mineralogy, is calcareous, and of a yellowish-grey colour. It occurs solid, but generally porous, and marked with impressions of reeds, moss, and other vegetables: it is soft, easily frangible, and not much heavier than water: it effervesces with acids, and is little else than

carbonate of lime. The more compact kinds are employed in building.

TULBAGIA, in botany, a genus of the Hexandria Monogynia class and order. Natural order of Spathaceæ. Narcissi, Jussieu. Essential character: corolla funnel-form, with a six-cleft border; nectary crowning the aperture, three-leaved; leaflets bifid, the size of the border; capsule superior. There are two species; *viz.* T. alliacea, narcissus-leaved tulbagia; and T. cepacea: both natives of the Cape of Good Hope.

TULIPA, in botany, *tulip*, a genus of the Hexandria Monogynia class and order. Natural order of Coronariæ. Lilia, Jussieu. Essential character: corolla six-petalled, bell-shaped; style none. There are five species.

TUN, or TON, originally signifies a large vessel or cask of an oblong form, biggest in the middle, and diminishing towards its two ends, girt about with hoops, and used for stowing several kinds of merchandize, for convenience of carriage; as brandy, oil, sugar, skins, hats, &c. This word is also used for certain vessels of extraordinary bigness, serving to keep wine in for several years.

TUN is also a certain measure for liquids; as wine, oil, &c. See MEASURE.

TUN is also a certain weight whereby the burden of ships, &c. is estimated.

TUNE, or TONE, *in music*, is that property of sounds by which they come under the relation of acute and grave. If two or more sounds be compared together in this relation, they are either equal or unequal in the degree of tune; such as are equal, are called unisons; the unequal constitute what are called intervals, which are the differences of tone between sounds. Sonorous bodies are found to differ in tone: 1st. According to the different kinds of matter: thus the sound of a piece of gold is much graver than that of a piece of silver of the same shape and dimensions. 2d. According to the different quantities of the same matter in bodies of the same figure; as a solid sphere of brass, of one foot diameter, sounds acuter than a sphere of brass of two feet diameter. But the measures of tone are only to be sought in the relations of the motions that are the cause of sound, which are most discernible in the vibration of chords. Now, in general, we find that in two chords, all things being equal excepting the tension, the thickness, or the length, the tones are different; which difference can only be in the velocity of their vibratory motions, by which they perform a different number of vibrations in the same time; as it is known that all the small vibrations of the same chord are performed in equal times. Now the frequenter or quicker those vibrations are, the more acute is the tone; and the slower and fewer they are in the same space of time, by so much the more grave is the tone. So that any given note of a tune is made by one certain measure of velocity of vibrations, that is, such a certain number of vibrations of a chord or string, in such a certain space of time, constitute a determinate tone.

TUNGSTATE. See TUNGSTIC *acid*.

TUNGSTEN, in mineralogy, is usually of a yellowish and greyish white: it occurs massive, disseminated, and very frequently crystallized: it sometimes occurs in large, coarse, and small granular distinct concretions, with streaked and shining surfaces. Its specific gravity is from 4.3 to 6. It is infusible, without addition, before the blow-pipe. It melts with borax, but scarcely changes its colour. When pulverized and digested with nitrous or muriatic acid, it leaves a yellow residue, which is the oxide of tungsten. The mineral contains, according to Scheele,

Yellow oxide of tungsten	65
Lime	31
Silica	4
	100

This specimen was obtained in Sweden: a specimen from Cornwall, analyzed by Klaproth, yielded

Yellow oxide of tungsten	75.25
Lime	18.70
Oxide of iron	1.25
——— manganese	0.75
Silica	1.50
	97.45
Loss	2.55
	100

It occurs in primitive mountains, and belongs to the oldest metalliferous formations. It is usually accompanied with tinstone, wolfram, quartz, mica, steatite, fluor-spar, &c. The Cornish tungsten is accompanied with iron-stone and hematite. It is found in Cornwall, Sweden, Saxony, and Germany. It is distinguished from tinstone by its octahedral crystals, the intensity of its lustre, its hard-

ness, and its greater specific gravity. When Bergman analyzed this mineral, he conjectured that the basis of the acid might be a metallic substance. This metallic substance has been only found in the state of acid, in combination with lime, iron, manganese, and lead. When it is combined with lime, it is the tungsten of the Swedes; and in combination with iron, it is called wolfram. To obtain this metal from the acid, it is mixed with charcoal in a crucible, and exposed to a very strong heat. By this process the metal was obtained in the form of a small button at the bottom of the crucible, in the first experiments which were made upon it by the German chemists. This crumbled to pieces between the fingers; and when it was examined with a magnifying glass, it was found to consist of a number of metallic globules, none of which were larger than a pin head. The colour of this metal is a steel grey. The specific gravity is 17.6, or, according to others, 17.22. It is one of the hardest of the metals. It is also one of the most infusible, requiring a temperature of 170° Wedgwood.

It crystallizes on cooling. When it is heated in the open air, it is readily converted into a yellow oxide, which afterwards, by a stronger heat, becomes of a black colour; and then by combining with a greater proportion of oxygen, it assumes the character of an acid, namely, the tungstic acid, whose properties and combinations with alkalies and earths will be presently described.

Tungsten combines with phosphorus, forming a phosphuret, the properties of which are unknown. It also combines with sulphur, forming a sulphuret of a bluish black colour, and which may be crystallized. There is no action between this metal and sulphuric, nitric, or muriatic acids. It is only acted on by nitromuriatic acid at a boiling temperature, and nitrous gas is disengaged. Nothing therefore is known of the combinations of tungsten with the other acids. This metal combines with the other metals, and forms alloys with them.

TUNGSTIC *acid*. In the year 1781, Scheele and Bergman, in investigating the nature of tungsten by the Swedes, discovered that it is composed of lime combined with a peculiar acid. Their discovery was afterwards confirmed by several chemists, who detected the same acid in the mineral called wolfram. This acid always exists in combination with lime and iron. It may be obtained by reducing the former to a fine powder, and treating it with nitric or muriatic acids, which unite with the lime; and then by alkalies, which dissolve the acid. The alkaline solution is to be precipitated by the nitric or muriatic acid; the precipitate is to be carefully washed and dried, which is the tungstic acid in the solid state. The tungstic acid thus prepared, is in the form of a white powder, which has an acid and metallic taste, changes the colour of vegetable blues into red, and has a specific gravity, according to Bergman, equal to 3.6. Heated before the blow-pipe, the tungstic acid becomes first yellow, then brown, and at last black; it affords no smoke, and gives no sign of fusion. When it is calcined for some time in a crucible, it is deprived of the property of dissolving in water. Exposed to the air it suffers no change. It is soluble in twenty parts of boiling water, but it is partially separated on cooling.

This solution has an acid taste, and reddens the tincture of turnsole. Heated with charcoal, it is reduced, but with difficulty, to the metallic state. With sulphur and phosphorus it becomes of a grey colour, but without reduction. The acids do not dissolve the tungstic acid in the form of white powder, but they change completely its properties. The sulphuric acid changes it to a blue, and the nitric and muriatic acids convert it into a fine yellow colour. In this state it has lost its taste and solubility, has become specifically heavier, and has acquired the property of forming salts with the same bases, distinctly different from those formed with what was called the white acid. The compounds which it forms with the alkalies, earths, and metallic oxides, are a species of neutral salts; but the chemical combination is not fully completed to hide the alkaline properties of the former. In forming these compounds, it is the only property in which it agrees with the acids. The compounds are denominated tungstates.

TUNNAGE is used for a custom or impost, payable to the crown, for goods and merchandize imported or exported, and is to be paid after a certain rate for every tun thereof. This duty, as well as that of poundage, was first granted for life to King Charles II. and has been continued in the same manner to his royal successors, down to his present majesty King George III.

TUNNEL *net*, a net for taking partridges, which should not exceed fifteen

feet in length, nor be less than eighteen inches in breadth, or opening, for the entrance.

TUPIPORA, in natural history, a genus of the Vermes Zoophyta; animal a nereis; coral consisting of erect, hollow, cylindrical, parallel, aggregate tubes. There are ten species, of which we notice T. musica, with fasciculate connected tubes, and transverse, distinct, membranaceous dissepiments. It inhabits the Indian and American seas, fixed to rocks and other corals: it is of a bright scarlet colour, consisting of an assortment of upright parallel tubes, rising over each other by stages like cells of an honeycomb, divided by common transverse partitions. The Indians use it in cases of stranguary, and wounds inflicted by venomous animals.

TURBITH *mineral.* If sulphuric acid and mercury, namely, three parts of acid and two of mercury, be exposed for a longer time to the action of heat, a greater proportion of sulphuric acid is decomposed, and the mercury combines with a greater proportion of oxygen. The salt thus obtained possesses different properties from the former. It crystallizes in small prisms, and when it is neutralized it is of a dirty white colour; but if it be obtained in the dry state, it is pure white, and in this state it is combined with an excess of acid. It is then deliquescent in the air; but in the neutral state it undergoes no change. When hot water is added to this salt, it is converted into a yellow powder, which has been long distinguished by the name of turpeth mineral.

TURBO, in natural history, *wreath*; a genus of the Vermes Testacea class and order: animal a limax; shell univalve, spiral, solid; aperture contracted, orbicular, entire. This is a very numerous genus, divided into sections. A. pillar-margin of the aperture dilated imperforate. B. solid imperforate. C. solid perforated. D. cancellate. E. Tapering.

TURDUS, the *thrush*, in natural history, a genus of birds of the order Passeres. Generic character: bill straitish, upper mandible somewhat bending, and notched near the point; nostrils oval, and half-covered with a small membrane, or naked; mouth ciliated with a few bristles at the corners; tongue jagged. There are one hundred and twenty-two species enumerated by Latham, and one hundred and thirty-five by Gmelin, of which we shall notice the following:

T. viscivorus, or the missel-thrush. This bird is well known throughout Europe, and some think confined to it. In England it is stationary, in some other countries migratory. It builds its nest of moss and leaves in low trees, or rather shrubs, and lays four eggs. It feeds on the berries of holly, hawthorn, and other trees, and on caterpillars and insects. It is valued for food, but far more for that melody, which ought ever to be its security from the gun of the sportsman, and which it frequently commences so early as the very beginning of the year, animating the dulness, and softening the rigour of the season by its delightful song.

T. musicus, or the throstle, is nine inches long, and weighs three ounces, being considerably less than the former. It breeds so early as the beginning of April, and sometimes again in each of the two following months. Its nest is made of earth, straw, and moss, and plastered inside with clay. It is never seen in companies in England, where it remains through the whole year: in France it is migratory. Its song commences early in the season, and continues for nine months; and its notes are so rich and various, that, in the language of Milton, they can "charm all sadness but despair."

T. pilaris, or the field-fare, is ten inches long, passes the winter in England, when the season is extremely rigorous, in immense flocks, but in small parties when the winter is mild. These birds are said to have been much esteemed for the table by the Romans. In Sweden they build in high trees. They subsist principally on various sorts of berries.

T. merula, or the black bird, is ten inches long, and found generally throughout Europe. It is fond of solitude, and never, or very rarely, seen in flocks. In summer it haunts orchards and gardens. In winter it secludes far from human society in the recesses of the woods. It builds in the same situation, and with the same materials, as the throstle, and may be easily reared, tamed, and taught to imitate a variety of tunes, and to articulate words and phrases. But its natural song is far superior to all its efforts of imitation, and when listened to from a moderate distance, for its sound is very strong, has a most cheering and transporting effect.

T. cinclus, or the water-ouzel, is rather less than the former, is solitary, and

met with in various parts of England, subsisting not only upon insects but fish, which it procures by diving, and walking or running after them at the bottom of the water. It is said to have been taken by a line and hook, having snatched at the bait intended for fish. It is able to sustain extreme cold, and does not quit its watery haunts till the streams are frozen. It builds in the banks of rivers.

The musician thrush is four inches long, and a native of Cayenne, where it subsists principally on ants. It never quits trees but to procure its sustenance. It is called in Cayenne the musician, by way of eminence. It is said to deliver first seven notes of the octave, and then to whistle various airs in different tones, sometimes resembling the flute, at others the human whistle; and when it displays its most skilful efforts, it is preferred by some even to the nightingale. Its habits are solitary.

T. migratorius, or the red breasted robin, is a common and familiar bird in almost every part of North America.

TURKEY. See Mileagris.

TURMERIC, a root which is cultivated largely in the East Indies; consists of a large oval bulb, from which spring two or three tortuous processes, three or four inches long. It has a fragrant smell, and an aromatic taste. The yellow colour which it exhibits is easily extracted, both by water and alcohol, and is sometimes used as a dye, which is very fugitive; therefore when employed in dyeing, it is chiefly to give a finishing gloss to the more solid colours, which soon fades away. The yellow of turmeric is rendered paler by the acids, but is changed to a brick-red by the alkalies: hence its great sensibility to alkaline tests. To apply it to this purpose, either a spirituous tincture or a watery infusion may be used; or, still more simply, a fresh cut surface of the entire root may be wetted with distilled water, and by being rubbed on white paper a visible yellow mark will be made, on which a drop of the liquor to be examined may be dropped. If the quantity of alkali be very small, it requires a few minutes to produce the full change.

TURNERA, in botany, so named in memory of William Turner, M. D. a genus of the Pentandria Trigynia class and order. Natural order of Columniferæ. Portulaceæ, Jussieu. Essential character: calyx five-cleft, funnel-form, exterior two-leaved; petals five, inserted into the calyx; stigmas multifid; capsule one-celled, three-valved. There are nine species.

TURNING, in mechanics, a very ingenious and useful art, by which a great variety of articles are manufactured, by cutting or fashioning them while they revolve upon an axis or line, which in most cases remains immoveable. Every solid substance in nature may be submitted to this process, and accordingly we have articles turned in the metals, in wood, in pottery, in stone, in ivory, &c. so numerous, and so universally in use, that it would be superfluous to enumerate or point them out. In the present article we shall describe the art in a general way, sufficient to show its principles, and may be of utility in practice.

The simplest process of turning is that of the potter, who, in the first stage of forming his ware, sticks a piece of humid clay upon a wheel, or flat table, while it revolves horizontally; and in this state of rotation of the clay, he fashions it with the greatest facility into vessels of every description. But in most operations of the art, the revolving body is cut or shaved by applying a chissel, or other suitable tool, to its surface, while in motion; a condition that requires firmness in the axis of rotation, and also that the tool itself should be steadily supported. The instrument or apparatus for these purposes, is called a Lathe. See the article. Among the great varieties of lathes, it is indispensably required, for circular turning, that the work should be supported by two steady centres, or by parts equivalent to two centres, at a distance from each other in the axis of rotation, and that the tool should be supported by a steady bar, or piece, called the rest. The mechanism for causing the rotation has been described in the article just referred to.

A great number of turned articles either have, or will admit of, a perforation through their axis. All wheel-work, and most of the articles turned in wood, are of this description. Clock and watchmakers accordingly use a very cheap, simple, and portable lathe, called a turn-bench, consisting of a straight bar of iron, about five inches long, with two cross bars or heads, about two inches long, one fixed at the end of the long bar, and the other capable of being shifted by means of a socket and screw. In each of these heads is a centre-pin, terminating in a point at one end, and in a central hole at the other, like the centre-pin in the poppet head of any other lathe; the

use of which is to afford point-centres when the points are turned towards each other, or hole-centres when the contrary is the case; and lastly, there is a small rest with its support, slidable and adjustable along the bar, as in another lathe. These instruments, which cost five or six shillings at the watch tool shops, will therefore support any piece of four or five inches long, and three inches diameter between the centres, and the method of producing the rotation is by passing the catgut string of a bow once or twice round the work, and drawing the bow backwards and forwards with one hand, while the other is employed in applying the tool. The turn-bench itself is held steady in a vice fixed to a bench or stand.

Such pieces as have a hole through the centre are drawn tightly upon an arbor or mandrel, having a pulley or ferril fixed upon it, to carry the gut or bow-string, and the mandrel itself is turned between the centres upon its own pointed extremities. There are mandrels fitted up in different ways for holding the work firmly, and if flat, at right angles to the motion; but we cannot consistently with brevity enter upon a description of them, which will immediately be understood by inspection in a workshop.

The common lathe of the turners in wood, called the pole-lathe, is the same thing as the watchmakers' turn-bench, but upon a large scale, and a little varied. Instead of the horizontal bar it has two long stout bars of wood, called sheers, forming what is called the bed of the lathe, and its two poppet-heads are upright blocks of wood, mortised in between the sheers, above which they rise and carry the centre screws, and between which they are moveable, and may be wedged firmly at any required distance from each other. The work itself is either put between the centres, or upon a wooden mandril, and it is made to revolve by a string or band, proceeding from a long springing pole at the ceiling or roof of the shop, round the work, and thence to a treadle or foot-board, which acts by alternate pressure from the foot, while the workman applies the cutting tool with his hands.

In these, and all similar lathes, the rotation is made backwards and forwards; and there are some kinds of work in which such a motion is advantageous; but in general it is much preferable that the work should constantly revolve the same way, as shown in the lathe described under that article, usually known by the name of the foot-lathe. In the regular foot-lathe, work is very seldom turned between the opposite centres, though this method certainly affords great truth and precision. The mandrel is here an essential part of the apparatus, which is always used. It has been shown that it is supported by a centre on the left hand, called the back centre, and by a steel collar in the middle poppet-head; and that the right hand extremity, or nose of the mandrel, terminates in a screw, either convex or concave, the latter of which is preferred in the best lathes. The various description of pieces screwed upon the nose of the mandrel, for holding or carrying work, are called chucks, probably because the work is mostly fastened by being driven, jammed, or choked into them.

When work is to be turned between centres by the foot-lathe, a centre-chuck, or steel-piece, carrying a projecting point, is screwed on the nose of the mandrel; and as this piece is not harder than blue, and may not always screw home to exactly the same bearing, accurate workmen are in the habit of turning or shaving the point in its place, so that it shall be truly centered. The opposite centre is afforded by the moveable poppet-head, and ought to be truly in the axis; and the mandrel is made to carry the work round by an arm and pin, or by any other ready method of connection.

Work, which is not to be turned between centres, is usually fastened to, or fixed in, a block or wooden chuck screwed on the mandrel. As it would be almost impossible to screw a wooden chuck upon the convex nose of a mandrel, and take it off as occasion required during the process, without altering the position, it is found much best that the screw of the mandrel should be hollow, and a brass chuck screwed therein, having its projecting screw to receive the wooden chuck; because, by this means, the work may be taken off repeatedly, if needful, without ever separating the brass and the wood; and the brass and the steel will take the same position when screwed together again.

Metallic or other work may be fastened to a wooden chuck by cement, or by glue, or by turning a cell in the wood, and driving the work gently and carefully into it till fixed.

The stronger, the firmer, and the better the workmanship of a lathe, the easier it will be to perform work with expe-

dition and truth; but a good workman will make true and excellent work with a very indifferent lathe, by taking care to cut so little at a time that the parts of the engine may never be shaken out of their contact. Metallic lathes, if ever so strong, have an elastic tremor, which makes it difficult to cut brass and bell-metal as firmly and smoothly as in wooden lathes, but the structure of the former admits of greater precision and truth. In a well constructed lathe, the back centre, the centre of the collar, and the fore centre, or centre of the moveable poppet-head, ought to be in one line, parallel to the bed or sheers. To prove this by trial, set the moveable poppet-head as far to the right hand as possible, and screw a stick of wood into the nose of the mandrel: into the middle of the right hand end of the stick, or nearly so, drive a pin or other projecting point, and by gentle blows against the stick, cause the point to remain steady in the axis, while the mandrel is turned round. If the centre point of the moveable poppet be truly opposite to this revolving point, the three centres are in a line; and if the same continues to be the case when the face of the moveable poppet is reversed, it is a proof that the hole in the poppet is bored parallel to the bed: and if the same adjustment continues when the stick is shortened, it shows that the bed is straight and parallel to the axis of work. If the collar and back centre, and the chamfer and point of the mandrel, in a lathe, be truly formed, and set square, the rotation slowly made by hand, when the back centre is rather firmly set up, will be equally stiff in every part, and the wearing parts when examined, will have the same aspect, slope, and grain, in every part of their surfaces.

The velocity of rotation may be extremely swift in wood, slower in brass and bell-metal, still slower in cast iron, and slowest of all in forged iron or steel. The reason for these limits appears to be, that a certain time is requisite for the act of cutting to take place, and that the tool itself, if heated by rotation, will instantly become soft, and cease to cut. Steel and iron require to be kept wetted. For rough work in wood the guage is a good tool, and after that the chisel, with its edge a little convex, rather than strait lined. The graver is commonly used for metal; and for strong rough work, the hook tool, which is of excellent advantage, even in small work, on account of its extreme steadiness. When steel is to be cut extremely clean, a sharp hard tool may be useful; but for the most part, in metallic work, even of steel, (if annealed,) the hook tool, or graver, need not be harder than purple, or even blue. But to cut steel work or chill cast iron cylinders at a high temper, the tool must be very hard, the angle of edge obtuse, (say seventy degrees,) and the motion slow.

Hitherto we have spoken of plain turning, which is indeed the most useful and most universally practised. But many other nice and very curious operations are performed by this art. If the poppet-heads, supporting the mandrel, be made regularly to move from side to side, during the rotation, or the rest be made to approach to, and recede from, the work, any number of times in a turn, the cuts will not be circular, but undulating, indented or waved in any curve that may be required. Work of this kind, which is chiefly done in watch cases, snuff boxes, and trinkets, is called rose-work. The motion is commonly regulated by certain round plates of brass fixed on the mandrel, called roves, which have their edges waved, and are called roses.

Another deviation from regular turning is effected by causing the chuck, which carries the work, to recede crosswise from the centre of the mandrel, back and forward during the rotation. The effect of this is, that the diameters of the work are not all equal to each other. It is practicable to produce a variety of curves in this way, but in our art the process is confined to turning ovals; and the chuck, by which the work is made thus to slide back and forward, is called an oval chuck.

Numerous geometrical figures are produced by turning, by an apparatus upon the principle of the geometrical pen of Suardi, in engines which have been made for curiosity, and at great expense.

Medallions, and other similar pieces, are produced by regulating the action of the tool in its advance to, or recess from, the face of a piece exposed to its action.

If the mandrel of a lathe be made to advance and recede in the line of the axis, once in each turn, the cut will not be in a plane at right angles to the axis of the work, and the line traced upon the work will be an ellipsis, produced by the oblique section of a cylinder. This kind of work is called swash-work, and may be seen in some old balustrades, where its effect is far from being pleasing. The nature of the curve thus described, which

we have called an ellipsis, will manifestly vary according to the law of the alternate motion in the mandrel. When the mandrel moves uniformly forward, the cut will be the common helix or screw; and the motion is used to make screws, though not very frequently, because good turners can easily make them by a notched cutting tool, called the screw.

The act of turning is so extensively applicable, that it would require a volume to describe its uses, and the methods of practising it. Every round thing which is made by human hands may be referred to this art, as one of its products. The largest columns, the most ponderous artillery, and the minutest pivots of watch-work, with all wheel-work, rotatory machines, vessels, &c. are worked in this method.

TURNSOLE. See LITMUS.

TURPENTINE. See RESINS.

Turpentine, of which there are various kinds, are all products of some of the species of the pinus. From this genus are obtained not only turpentine, but resin, pitch, tar, &c. which are employed so extensively in ship-building, and in the rigging also: likewise in varnishes.

There are three varieties of pine turpentine, commonly known under that name in Europe: namely, 1. The common turpentine, obtained chiefly from the pinus sylvestris (Scotch fir). 2. The Strasburgh turpentine, yielded by the pinus picca (silver fir). And, 3. The Venice turpentine, procured from the pinus larix (larch). Of the three first mentioned turpentines, the Venice is the thinnest and most aromatic; the Strasburgh the next in these qualities; and the common is the firmest and coarsest. The two former are often adulterated by a mixture of the common turpentine and oil of turpentine; and it is to be observed, that the terms Venice and Strasburgh turpentine are not now appropriate, as they are procured from various countries.

Common turpentine is obtained largely in the pine forests in the south of France, in Switzerland, in the countries on the north of the Pyrenees, in Germany, and in many of the southern States of North America. The greater part of what is consumed in this country is imported from North America. The method of obtaining it is by making a series of incisions through the bark of the tree, from which the turpentine exudes, and falls down into holes, or other receptacles at the foot.

The process is described very accurately by Duhamel and others, as practised in the south of France. The fir is generally allowed to remain untouched till it is thirty or forty years old. When it is to be worked, which is early in the spring, a small hole is first made in the ground at the foot of the tree, the earth of which is well rammed, and serves as a receptacle for the juice. The coarse bark is then stripped off from the tree, a little above the hole, down to the smooth inner bark, after which a portion of the inner bark, together with a little of the wood, is cut out with a very sharp tool, so that there may be a wound in the tree about three inches square, and an inch deep. Immediately afterwards the turpentine begins to exude in very transparent drops, which escape chiefly from the wood immediately under the inner bark. The hotter the weather is, the greater is the supply of resin; and to facilitate the supply, the incisions are enlarged every three or four days, by cutting off thin slices, till at the end of the year it is about a foot and a half wide, and two or three inches deep. The whole time during which the turpentine flows is from the end of February to October. In the winter it entirely ceases, but in the ensuing spring a fresh incision is begun a little above the former, and managed in the same manner. This practice is continued annually for about twelve or fifteen years in some parts, and in others a shorter time, on the same side of the tree, till the later incisions are so high as to be out of reach without the assistance of steps; after which the contrary side of the tree is begun upon, and worked in a similar manner for as many years, during which time the first incisions are grown up, and are fit to be cut afresh. In this way, a healthy tree, in a favourable soil, may be made to yield from six to twelve, or more, pounds of turpentine annually, sometimes for a century; and even the timber is not soon injured by this constant drain. The flow of turpentine discontinues altogether about October, and the liquid resin collected during the year, from each tree, is put together for further purification. But a considerable quantity of the resin has concreted during that time around the incision, particularly as the heat declines; and in the winter, when it has hardened considerably, it is scraped off, and forms what is technically called barras, or in some provinces galipot, which differs from the more liquid turpentine in consistence, and probably contains a less proportion of essential oil. The galipot is

much used in making flambeaux when mixed with suet; but the greater part of it, as well the liquid turpentine, is subjected to further processes.

The Strasburgh turpentine, the produce of the silver fir, is the most fragrant of all the pine turpentines, and only inferior to the true Chio; but it is not often seen in the shops. It is obtained by rude incision of the bark by the peasants in the vast pine forests on the western Alps. The first cut is made as high as the hatchet will reach, and these are renewed annually from above downwards to within a foot of the ground. But the finest kind of turpentine yielded by this tree, is that which exudes from soft tubercles, or swellings of the inner bark. The peasants carry with them a large cow's horn, with the point of which they pierce these tubercles, and collect the juice in its hollow.

The true Venice turpentine, or resin of the larch, is obtained from the Tyrol and Savoy, and also from Dauphiny, by boring holes about an inch in diameter, with a gentle descent, in the most knotty parts of the tree. To these are adapted long perforated pegs, which serve as gutters to convey the juice into troughs placed beneath. It is yielded during the whole of the summer, and is simply purified by straining through hair sieves. A full grown larch will sometimes yield seven or eight pounds of turpentine annually for forty or fifty years.

TURQUOISE. The colour of this substance is pale sky-blue, passing into indigo-blue, and pale apple-green. It occurs in mass, or disseminated. Its fracture is even. Its hardness is nearly equal to that of glass; it is difficultly frangible. Specific gravity 3.12. Before the blowpipe its colour changes to greyish-white, and it becomes friable, but it does not melt. It is soluble in nitro-muriatic acid, and the European varieties are so in nitric acid; this menstruum, however, has no action on the Persian turquoises. It is composed, according to Buillon la Grange, of

Phosphate of lime . . .	80
Carbonate of lime . . .	8
Phosphate of iron, with a trace of manganese .	2
Phosphate of magnesia .	2
Alumina	1
Water	6
Loss	1
	100

Turquoise is generally considered as fossil-bone, or ivory penetrated by oxide of copper; it appears, however, from the above analysis, that the colouring matter is phosphate of iron. The oriental turquoises are found near Meched in Persia, also in Mount Caucasus, in Egypt and Arabia. The occidental ones are found in Languedoc in France, and in Hungary. Turquoise was formerly in some estimation for rings and other articles of personal ornament; but its value has greatly declined in modern times. The colour of turquoise changes gradually by exposure to the air, from blue to green: when it arrives at this state, its commercial value is wholly extinct.

TURRITIS, in botany, *tower-mustard*, a genus of the Tetradynamia Siliquosa class and order. Natural order of Siliquosæ, Cruciformes, or Cruciferæ. Essential character: silique very long, angular; calyx converging, erect; corolla erect. There are eight species.

TURRÆA, in botany, a genus of the Decandria Monogynia class and order. Natural order of Trihilatæ. Meliæ, Jussieu. Essential character: calyx five-toothed; petals five; nectary toothed, cylindrical, bearing the anthers at the mouth between the teeth; capsule pentacoccous; seeds two. There are five species.

TUSCAN *order*, in architecture, the first, simplest, and most massive of the five orders.

TUSSILAGO, in botany, *colt's-foot*, a genus of the Syngenesia Polygamia Superflua class and order. Natural order of Compositæ Discoideæ. Corymbiferæ, Jussieu. Essential character: calyx scales equal, as long as the disk, somewhat membranaceous; down simple; receptacle naked. There are fourteen species.

TWILIGHT, that light, whether in the morning before sun-rise, or in the evening after sun-set, supposed to begin and end when the least stars that can be seen by the naked eye cease, or begin to appear. By means of the atmosphere it happens, that though none of the sun's direct rays can come to us after it is set, yet we still enjoy its reflected light for some time, and night approaches by degrees; for after the sun is hidden from our eyes, the upper part of our atmosphere remains for some time exposed to its rays, and from thence the whole is illuminated by reflection. But as the sun grows lower and lower, that portion of the atmosphere which is above our horizon, becomes enlightened till the sun has

got eighteen degrees below it; after which it ceases to be illuminated thereby, till it has got within as many degrees of the eastern side of the horizon; at which time it begins to illuminate the atmosphere again, and in appearance to diffuse its light throughout the heavens, which continues to increase till the sun be up. Hence it is, that during that part of the year in which the sun is never eighteen degrees below our horizon, there is a continued twilight from sun-setting to sun-rising. Now that part of the year in the latitude of London is, while the sun is passing from about the fifth degree of Gemini to the twelfth of Cancer; that is, from the middle of May to the middle of July.

As the twilight depends on the quantity of matter in the atmosphere fit to reflect the sun's rays, and also on the height of it (for the higher the atmosphere is, the longer will it be before the upper parts of it will cease to be illuminated,) the duration of it will be various. For instance, in winter, when the air is condensed with cold, and the atmosphere upon that account lower, the twilight will be shorter; and in summer, when the limits of the atmosphere are extended by the rarefaction and dilatation of the air of which it consists, the duration of the twilight will be greater. And for the like reason, the morning twilight, the air being at that time condensed and contracted by the cold of the preceding night, will be shorter than the evening one, when the air is more dilated and expanded.

The beginning and end of twilight has been variously stated, by different observers; but, in our latitude, it may be said to begin and end when the sun is about eighteen degrees below the horizon: hence, when refraction is allowed for, the atmosphere must be capable of reflecting sensible light at the height of about forty miles. The duration of twilight is greater or less, as the sun moves more or less obliquely with respect to the horizon: hence it is shortest near the time of the equinoxes, because the equinoxial intersects the horizon less obliquely than any lesser circle parallel to it. Dr. Long has calculated the duration of twilight, in different latitudes, and for the several different declinations of the sun: the result he laid before the public in the following table, where the letters *c d* signify that it is then continual day; *c n* continual night; and *w n*, that the twilight lasts the whole night:

TABLE.

Latitude.	0	10	20	30	40	45	50	52½	55	60	65	70	75	80	85	90
☉ Enters	h.m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.	h. m.
♋	1 18	1 21	1 28	1 41	2 8	2 39	w n	w n	w n	w n	w n	c d	c d	c d	c d	c d
♊ ♌	1 16	1 19	1 25	1 36	1 58	2 19	3 3	w n	w n	w n	w n	c d	c d	c d	c d	c d
♉ ♍	1 13	1 15	1 20	1 28	1 43	1 55	2 12	2 25	2 41	3 55	w n	w n	w n	c d	c d	c d
♈ ♎	1 12	1 13	1 17	1 24	1 35	1 44	1 55	2 2	2 10	2 33	3 8	4 18	w n	w n	w n	w n
♓ ♏	1 13	1 14	1 18	1 24	1 35	1 43	1 54	2 0	2 8	2 27	2 56	8 41	5 2	17 32	w n	w n
♒ ♐	1 16	1 17	1 21	1 28	1 40	1 49	2 1	2 8	2 18	2 43	3 26	11 38	11 14	10 32	8 38	c n
♑	1 18	1 19	1 23	1 30	1 43	1 53	2 6	2 15	2 26	2 57	4 4	10 24	9 30	7 46	c n	c n

TYCHONIC *system*, or *hypothesis*, an order or arrangement of the heavenly bodies, of an intermediate nature between the Copernican and Ptolemaic, or parti-

cipating alike of them both. This system had its name and original from Tycho Brahe, a nobleman of Denmark, who lived in the latter part of the last century. The philosopher, though he approved of the Copernican system, yet could not reconcile himself to the motion of the earth; and being, on the other hand, convinced the Ptolemaic scheme could not be true, he contrived one different from either. In this the earth has no motion allowed it, but the annual and diurnal phenomena are solved by the motion of the sun about the earth, as in the Ptolemaic scheme; and those of Mercury and Venus are solved by this contrivance, though not in the same manner, nor so simply and naturally as in the Copernican system. The Tychonic system then supposed the earth in the centre of the world, that is, of the firmament of stars, and also of the orbits of the sun and moon; but at the same time it made the sun the centre of the planetary motions, *viz.* of the orbits of Mercury, Venus, Mars, Jupiter, and Saturn. Thus the sun, with all its planets, was made to revolve about the earth once a year, to solve the phenomena arising from the annual motion; and every twenty-four hours, to account for those of the diurnal motion.

TYGER. See Felis.

TYLE, or Tile, in building, a sort of thin, fictitious, laminated brick, used on the roofs of houses; or, more properly, a kind of fat clayey earth, kneaded and moulded, of a just thickness, dried and burnt in a kiln like a brick, and used in the covering and paving of houses. See Brick.

There are various kinds of tyles, for the various occasions of building; as plain, thack, ridge, roof, crease, gutter, pan, crooked, Flemish, corner, hip, dormar, scallop, astragal, traverse, paving, and Dutch tyles.

Flemish or Dutch tyles are of two kinds, ancient and modern. The ancient were used for chimney foot-paces: they were painted with antique figures, and frequently with postures of soldiers; some with compartments, and sometimes with moresque devices: but they come much short of the design and colours of the modern ones. The modern Flemish tyles are commonly used plastered up in the jaumbs of chimnies, instead of chimney-corner stones. These are better glazed, and such as are painted (for some are only white) are done with more curious figures, and more lively colours, than the ancient ones. But both kinds seem to be made of the same whitish clay as our white glazed earthen ware; the modern ones are commonly painted with birds, flowers, &c. The ancient ones are only five inches and a quarter square, and about three-quarters of an inch thick; the modern ones six inches and a half square, and three-quarters of an inch thick.

TYMPAN, or Tympanum, in architecture, the area of a pediment, being that part which is on a level with the naked of the frieze. Or it is the space included between the three cornishes of a triangular pediment, or the two cornishes of a circular one. Sometimes the tympan is cut out, and the part filled with an iron lattice, to give light, and sometimes it is enriched with sculpture in basso relievo.

Tympan, among printers, a double frame belonging to the press, covered with parchment, on which the blank sheets are laid in order to be printed off. See Printing.

TYMPANUM, or Tympan, in mechanics, a kind of wheel placed round an axis, or cylindrical beam, on the top of which are two levers or fixed staves, for the more easy turning the axis, in order to raise a weight required. The tympanum is much the same with the peritrochium, but that the cylinder of the axis of the peritrochium is much shorter and less than the cylinder of the tympanum.

Tympanum *of a machine*, is also used for a hollow wheel, wherein one or more people, or other animals, walk, to turn it; such as that of some cranes, calenders, &c.

TYPE, a copy, image, or resemblance of some model. This word is much used among divines, to signify a symbol, sign, or figure of something to come; in which sense it is commonly used with relation to antitype, which is the thing itself, whereof the other is a type or figure.

TYPHA, in botany, a genus of the Monoecia Triandria class and order. Natural order of Calamariæ. Typhæ, Jussieu. Essential character: male, ament cylindrical; calyx indistinct, three-leaved; corolla none: female, ament cylindrical, below the males; calyx a villose hair; corolla none; seed one, placed on a capillary down. There are two species, *viz.* T. latifolia, great cat's tail, or reed mace; and T. angustifolia, narrow-leaved cat's tail.

TYPOGRAPHY, the art of printing. See Printing and Stereotype.

U.

U, Or u, the twentieth letter, and fifth vowel of our alphabet, is formed in the voice by a round configuration of the lips, and a greater extrusion of the under one than in forming the letter o, and the tongue is also more cannulated. The sound is short in *crust, must, tun, tub*; but is lengthened by a final *e*, as in, *tune, tube*, &c. In some words it is rather acute than long; as in *brute, flute, lute*, &c. It is mostly long in polysyllables; as in *union, curious*, &c. but in some words it is obscure, as in *nature, venture*, &c. This letter, in the form V, or v, is properly a consonant, and as such is placed before all the vowels; as in *vacant, venal, vibrate*, &c. Though the letters v and u had always two sounds, they had only the form v till the beginning of the fourth century, when the other form was introduced, the inconvenience of expressing two different sounds by the same letter having been observed long before. In numerals V stands for five, and with a dash added at top, thus $\overline{V}$, it signifies 5,000.

VACCINATION. See SURGERY.

VACCINIUM, in botany, *bilberry*, or *whortleberry*, a genus of the Octandria Monogynia class and order. Natural order of Bicornes. Ericæ, Jussieu. Essential character: calyx superior; corolla one petalled; filaments inserted into the receptacle; berry four-celled, many seeded. There are twenty-seven species.

VACUUM, in philosophy, denotes a space empty, or devoid, of all matter or body. It has been the opinion of some philosophers, particularly the Cartesians, that nature admits not a vacuum, but that the universe is entirely full of matter: in consequence of which opinion they were obliged to assert, that if every thing contained in a vessel could be taken out or annihilated, that sides of the vessel, however strong, would come together; but this is contrary to experience, for the greatest part of the air may be drawn out of a vessel by means of the air-pump, notwithstanding which it will remain whole, if its sides are strong enough to support the weight of the incumbent atmosphere. Should it be objected here, that it is impossible to extract all the air out of a vessel, and that there will not be a vacuum on that account; the answer is, that since a very great part of the air that was in the vessel may be drawn out, as appears by the more quick descent of light bodies in a receiver when exhausted of its air, there must be some vacuities between the parts of the remaining air; which is sufficient to constitute a vacuum. Indeed, to this it may be objected by a Cartesian, that those vacuities are filled with materia subtilis, that passes freely through the sides of the vessel, and gives no resistance to the falling bodies: but as the existence of this materia subtilis can never be proved, we are not obliged to allow the objection, especially since Sir Isaac Newton has found that all matter affords a resistance nearly in proportion to its density. There are many other arguments to prove this, particularly the motions of the comets through the heavenly regions, without any sensible resistance; the different weight of bodies of the same bulk, &c. All the parts of spaces, says Sir Isaac Newton, are not equally full; for if they were, the specific gravity of the fluid which would fill the region of the air could not, by reason of the exceeding great density of its matter, give way to the specific gravity of quicksilver, gold, or any body, how dense soever; whence neither gold, nor any other body, could descend in the air; for no body can descend in a fluid, unless it be specifically heavier than it. But if a quantity of matter may, by rarefaction, be diminished in a given space, why may it not diminish in infinitum? And if all the solid particles of bodies are of the same density, and cannot be rarified, without leaving pores, there must be a vacuum.

VADE *mecum*, or VENI *mecum*, a Latin phrase, used in English to express a thing that is very handy and familiar, and which one usually carries about with them; chiefly applied to some favourite book.

VAGINA, properly signifies a sheath, or scabbard: and the term vagina is used in architecture, for the part of a terminus, because resembling a sheath, out of which the statue seems to issue.

VAGINALIS, the *sheath-bill*, in natural history, a genus of birds of the order Grallæ. Generic character: bill strong, thick, compressed; upper mandible covered above with a moveable horny sheath; nostrils placed before the sheath; face naked and papillous; wings with an obtuse excrescence under the flexure; claws grooved. V. alba, or the white sheath-bill, the only species known,

is a native of New Zealand and the South Sea Islands. It is in length about sixteen inches. Its food consists of shell fish and putrid carcasses. Its legs are long, red, and naked a little above the knees.

VAGRANTS are all persons threatening to run away, and leave their wives and children to the parish. All persons unlawfully returning to the parish or place whence they have been legally removed by order of two justices, without bringing a certificate from the parish or place whereto they belong. All persons who have not wherewith to maintain themselves, live idle, and refuse to work for the usual wages given to other labourers in the like work, in the parishes or places where they are. All persons going from door to door, or placing themselves in the streets, highways, or passages, to beg or gather alms in the parishes or places where they dwell. All these shall be deemed idle and disorderly persons, and one justice may commit such offenders (being thereof convicted before him, by his own view, confession, or oath of one witness,) to the house of correction, to hard labour, not exceeding one month. And any person may apprehend and carry before a justice, any such persons going from door to door, or placing themselves in the streets, highways, or passages, to beg alms in the parishes or places where they dwell; and if they shall resist, or escape from the person apprehending them, they shall be punished as rogues and vagabonds. And the said justice, by warrant under his hand and seal, may order any overseer, where such offender shall be apprehended, to pay five shillings to any person in such parish or place so apprehending them, for every offender so apprehended; to be allowed in his accounts, on producing the justice's order and the person's receipt to whom it was paid. 17 George II. c. 5. The same statute also enacts, that such justice shall order the person so apprehended to be publicly whipped by the constable, petit-constable, or some other person to be appointed by such constable or petit-constable of the place where such offender was apprehended, or shall order him to be sent to the house of correction; and by 27 George III. c. 11, the common gaol, until the next sessions, or for any less time, as such justice shall think proper. To defray the expences of apprehending, conveying, and maintaining rogues, vagabonds, and incorrigible rogues, and all other expenses necessary, the justices, in sessions, may cause such sums as shall be necessary to be raised, in the same manner as the general county rate. 17 George III. c. 5.

VAHLIA, in botany, so named in honour of Martin Vahl, regius professor of botany, at Copenhagen, a genus of the Pentandria Digynia class and order. Natural order of Succulentæ. Onagræ, Jussieu. Essential character: calyx five-leaved; corolla five-petalled; capsule inferior, one-celled, many-seeded. There is only one species, *viz.* V. capensis, a native of the Cape of Good Hope, in sandy places.

VAIR, in heraldry, a kind of fur, consisting of divers little pieces, argent, and azure, resembling a Dutch U, or a bell-glass. Vairs have their point azure opposite their point argent, and the base argent to the base azure.

VAIRY, VAIRE, VERRY, or VARRY, in heraldry, expresses a coat, or the bearings of a coat, when charged or chequered with vairs: and hence, vary cuppy, or vairy tassy, is a bearing composed of pieces representing the tops of crutches.

VALANTIA, in botany, *cross-wort*, a genus of the Polygamia Monoecia class and order. Natural order of Stellatæ. Rubiaceæ, Jussieu. Essential character: hermaphrodite, calyx none; corolla four-parted; stamens four; style bifid; seed one; male, calyx none; corolla three or four-parted; stamens three or four; pistil obsolete. There are nine species.

VALENTINIA, in botany, a genus of the Octandria Monogynia class and order. Essential character: calyx five-parted, coloured, spreading; corolla none; capsule berried, four-seeded, pulpy. There is but one species, *viz.* V. ilicifolia, a native of Hispaniola, on the most barren rocks towards the ocean; also in Cuba, about the Havannah.

VALERIANA, in botany, *valerian*, a genus of the Triandria Monogynia class and order. Natural order of Aggregatæ. Dipsaceæ, Jussieu. Essential character: calyx none; corolla one-petalled; gibbous on one side of the base, superior; seed one. There are thirty-one species.

VALLISNERIA, in botany, a genus of the Dioecia Diandria class and order. Natural order of Palmæ. Hydrocharides, Jussieu. Essential character: male, spathe two-parted; spadix covered with floscules; corolla three-parted; female, spathe bifid, one-flowered; calyx three-parted, superior; stigma three-parted: capsule one-celled, many-seeded. There are two species, *viz.* V. spiralis, two-stamened vallisneria; and V. octandria, eight-stamened vallisneria.

VALUE, in commerce, denotes the price or worth of any thing: hence the intrinsic value denotes the real and effective worth of a thing, and is used chiefly with regard to money, the popular value whereof may be raised and lowered at the pleasure of the prince; but its real, or intrinsic value, depending wholly on its weight and fineness, is not at all affected by the stamp or impression thereon.

VALVE, in hydraulics, pneumatics, &c. is a kind of lid, or cover, of a tube or vessel, so contrived as to open one way; but which, the more forcibly it is pressed the other way, the closer it shuts the aperture; so that it either admits the entrance of a fluid into the tube or vessel, and prevents its return; or admits its escape, and prevents its re-entrance.

VALVE, in anatomy, a thin membrane, applied on several cavities and vessels of the body, to afford a passage to certain humours going one way, and prevent their reflux towards the place from whence they came. The veins and lymphatics are furnished with valves, which open towards the heart, but keep close towards the extremities of those vessels; that is, they let the blood and lymph pass towards the heart, but prevent their returning towards the extreme parts from whence they came.

VAN, in naval affairs, the foremost division of a naval armament, or that part which leads the way to battle, or advances first in the order of sailing.

VANDELLIA, in botany, a genus of the Didynamia Angiospermia class and order. Natural order of Personatæ. Scrophulariæ, Jussieu. Essential character: calyx four-parted; corolla ringent; filaments the two outer from the disk of the lip of the corolla; anthers connected by pairs; capsule one-celled, many-seeded. There are two species, *viz.* V. diffusa, and V. pratensis.

VANGUERIA, in botany, a genus of the Pentandria Monogynia class and order. Natural order of Aggregatæ. Rubiaceæ, Jussieu. Essential character: calyx five-toothed; corolla tube globular, with a hairy throat; stigma bilamellate; berry inferior; four or five-seeded. There is but one species, *viz.* V. edulis, supposed to be a native of China.

VAPOUR, in meteorology, a thin humid matter, which, being rarefied to a certain degree by the action of heat, ascends to a particular height in the atmosphere, where it is suspended, until it returns in the form of dew, rain, snow, &c. On this subject we refer our readers to the articles EVAPORATION and METEOROLOGY, and shall make a few additional observations on dew, which is a phenomenon proper to clear weather. It begins to be deposited about sun-set, is most constant in vallies, and on plains near rivers, and other collections of waters, and abounds on those parts of the surface which are clothed with vegetation. It is often suspended when rain is approaching, as likewise in windy weather; and before thunder storms; an unusually copious deposition however sometimes precedes rain. The following is said to be the usual appearance in the valley through which the Thames passes. After a clear warm day there is gradually formed on the horizon a continuous haze, rising sometimes to a considerable height, and often tinged by the setting sun with a fine gradation of red and violet shades. This is the precipitated water become faintly visible in its descent. Dew is always to be found on the grass by the time that this haze has become conspicuous, and its abundance is proportioned to the density and permanence of the latter. The following facts are deserving of notice.

In this country the dew is observed more copiously in the mornings of spring and summer than at other times in the year. Sometimes, however, in autumn and winter, an abundant dew is deposited in the night. In countries nearer the equator, the dews are generally observed in the morning throughout the whole year; and in some places they are so very copious as in a great measure to supply the deficiency of rain, which seldom falls in those places. The condensation of the vapour which forms the dew mostly takes place while the sun is below the horizon; the greatest deposition taking place soon after the setting of the sun. In cloudy weather there is little or no dew deposited: the most considerable quantity is observed in a morning, subsequent to a clear, still, and cool night, which has followed a pretty warm day. The lower parts of bodies that are exposed to the ambient air are first covered with dew. The most singular circumstance is, that dew is not deposited upon all kinds of substances indiscriminately: it falls upon certain bodies much more abundantly than on others, and upon some even not at all. The drops of dew attach themselves to glass, crystals, and porcelain, much more readily than to other bodies; next to these come the leaves of vegetables, wood, especially when varnished, and common earthen ware; but the dew adheres least

of all to all sorts of metallic bodies. We may now notice Mr. Dalton's observations, which are the result of a variety of well conducted and very accurate experiments on this subject. 1. That aqueous vapour is an elastic vapour *sui generis*, diffusible in the atmosphere, but forming no chemical combination with it. 2. That temperature alone limits the maximum of vapour in the atmosphere. 3. That there exists at all times, and in all places, a quantity of aqueous vapour in the atmosphere, variable according to circumstances. 4. That whatever quantity of aqueous vapour may exist in the atmosphere at any time, a certain temperature may be found, below which a portion of that vapour would unavoidably fall, or be deposited, in the form of rain or dew, but above which no such diminution could take place with chemical agency. This point may be called the extreme temperature of vapour of that density; and 5. That whenever any body colder than the extreme temperature of the existing vapour, is situated in the atmosphere, dew is deposited upon it, the quantity of which varies as the surface of the body, and the degree of cold below the extreme temperature. The reader may be referred to an excellent and elaborate article on this subject in Dr. Rees's New Cyclopedia, a work, of which it may be fairly and honourably said, that as it advances in its progress, it increases in merit and reputation.

VARIABLE *quantities*, in geometry and analytics, denote such as are either continually increasing or diminishing; in opposition to those which are constant, remaining always the same. Thus, the abscisses and ordinates of an ellipsis, or other curve line, are variable quantities, because they vary or change their magnitudes together. Some quantities may be variable by themselves alone, while those connected with them are constant: as the abscisses of a parallelogram, whose ordinates may be considered as all equal, and therefore constant. The diameter of a circle, and the parameter of a conic section, are constant, while their abscisses are variable. Variable quantities, (see FLUXIONS,) are usually denoted by the last letters of the alphabet z, y, x, while the constant ones are denoted by the first letters a, b, c.

VARIANCE, in law, signifies any alteration of a thing formerly laid in a plea, or where the declaration in a cause differs from the writ, or from the deed upon which it is grounded. If there be a variance between the declaration and the writ, it is error, and the writ shall abate; and if there appear to be a material variance between the matter pleaded and the manner of pleading it, this is not a good plea, for the manner and matter of pleading ought to agree in substance, or there will be no certainty in it. Cro. Jac. 479.

VARIATION *of curvature*, in geometry, is used for that inequality or change, which happens in the curvature of all curves except the circle; and this variation, or inequality, constitutes the quality of the curvature of any line. Sir Isaac Newton makes the index of the inequality or variation of curvature, to be the ratio of the fluxion of the radius of curvature to the fluxion of the curve; and Mr. Maclaurin, to avoid the perplexity that different notions, connected with the same terms, occasion to learners, has adapted the same definition; but he suggests, that this ratio gives rather the variation of the ray of curvature, and that it might have been proper to have measured the variation of curvature, rather by the ratio of the fluxion of curvature itself to the fluxion of the curve: so that the curvature being inversely as the radius of the curvature, and consequently its fluxion as the fluxion of the radius itself directly, and the square of the radius inversely, its variation would have been directly as the measure of it, according to Sir Isaac's definition, and inversely, as the square of the radius of curvature.

VARIATION *of the needle*, in magnetism. Although the north pole of the magnet in every part of the world, when suspended, points towards the northern parts, and the south pole to the southern parts, yet it seldom points exactly north and south. The angle, in which it deviates from due north and south, is called "The variation of the needle," or, "The variation of the compass," and this variation is said to be east or west, according as the north pole of the needle is eastward or westward of the meridian of the place. This deviation from the meridian is not the same in all parts of the world, but is different in different places, and it is almost perpetually varying in the same place. When the variation was first observed, the north pole of the magnetic needle declined eastward of the meridian of London, but it has since that time been changing towards the west; so that in the year 1657, the needle pointed due north and south; at present, it declines towards the west between 24° and 25°,

and it seems to be still advancing westward.

VARIEGATION, among botanists and florists, the act of streaking or diversifying the leaves, &c. of plants and flowers with several colours. Variegation is either natural or artificial. Of natural variegation there are four kinds; the first showing itself in yellow spots here and there, in the leaves of plants, called by gardeners the yellow bloach. The second kind, called the white bloach, marks the leaves with a great number of white spots, or stripes; the whitest lying next the surface of the leaves, usually accompanied with other marks of a greenish white, that lie deeper in the body of the leaves. The third, and most beautiful, is where the leaves are edged with white, being owing to some disorder or infection in the juices, which stains the natural complexion or verdure of the plant. The fourth kind is that called the yellow edge.

VARIGNON (PETER,) in biography, was born at Caen in 1654. He was the son of an architect, and intended at an early age for the church. Accident threw into his way a copy of Euclid's Elements, which gave him a strong bias towards mathematical learning. So intent was he in the pursuit of science, that he abridged himself of the necessaries of life, to purchase books to aid him in the pursuit. From his relations he met with much opposition, because they imagined that geometry and algebra would ill accord with the course of theological studies. While he was at college he became acquainted with the Abbé St. Pierre; and in their application to learning, they were mutually serviceable to one another. The abbé, to enjoy more of Varignon's company, determined to lodge with him; and sensible of his merit, he resolved to give him a fortune, that he might fully pursue the bent of his genius, and improve his talents; and out of only 1800 livres a year, which he had himself, he conferred 300 of them upon Varignon.

The abbé, persuaded that he could not do better than go to Paris to study philosophy, settled there in 1686, with M. Varignon, in the suburbs of St. Jacques. There each studied in his own way; the abbé applying himself to the study of men, manners, and the principles of government; whilst Varignon was wholly occupied with the mathematics.

"I," says Fontenelle, "who was their countryman, often went to see them, sometimes spending two or three days with them. They had also room for a couple of visitors, who came from the same province. We joined together with the greatest pleasure. We were young, full of the first ardour for knowledge, strongly united, and, what we were not then perhaps disposed to think so great a happiness, little known. Varignon, who had a strong constitution, at least in his youth, spent whole days in study, without any amusement or recreation, except walking sometimes in fine weather. I have heard him say, that in studying after supper, as he usually did, he was often surprised to hear the clock strike two in the morning; and was much pleased that four hours rest were sufficient to refresh him. He did not leave his studies with that heaviness which they usually create; nor with that weariness which a long application might occasion. He left off gay and lively, filled with pleasure, and impatient to renew it. In speaking of mathematics, he would laugh so freely, that it seemed as if he had studied for diversion. No condition was so much to be envied as his; his life was a continual enjoyment, delighting in quietness."

In the solitary suburb of St. Jacques he formed, however, a connection with many other learned men; as Du Hamel, Du Verney, De la Hire, &c. Du Verney often asked his assistance in those parts of anatomy connected with mechanics: they examined together the positions of the muscles, and their directions; hence Varignon learned a good deal of anatomy from Du Verney, which he repaid by the application of mathematical reasoning to that subject.

At length, in 1687, Varignon made himself known to the public by a treatise on new mechanics, dedicated to the Academy of Sciences. His thoughts on the subject were, in effect, quite new. He discovered truths, and laid open their sources. In this work he demonstrated the necessity of an equilibrium, in such cases as it happens in, though the cause of it is not exacly known. This discovery Varignon made by the theory of compound motions, and is what this essay turns upon. This new treatise on mechanics was greatly admired by the mathematicians, and procured the author two considerable places, the one of geometrician in the Academy of Sciences, the other of professor of mathematics in the college of Mazarine; to this honour he was the first person raised.

Varignon catched eagerly at the science of infinitesimals as soon as it appeared in the world, and became one of its

most early cultivators. Severe and unremitted study injured his health very much, and in 1705 he had a dangerous illness, which confined him to his bed many months, and the effects of which he did not recover for three years. Indeed it can scarcely be said that he ever perfectly regained the vigour which he had formerly enjoyed. He could not lay aside his studies, and these were deemed incompatible with his health. He died in 1722: by Fontenelle he is described as an excellent man, not apt to be jealous of the fame of others; he was as simple in his manners as his understanding was superior. He was at the head of the French mathematicians, and one of the best in Europe. He was apt to be over hasty when a new object presented itself; and too impetuous towards those who opposed him. His works, which were published separately, were "Projet d'une nouvelle Mechanique," 4to. "Des nouvelles Conjecture sur la Pesanteur." "Nouvelle Mechanique ou Statique." Besides a vast number of separate memoirs.

VARNISH. Lac varnishes, or lacquers, consist of different resins in a state of solution, of which the most common are, mastich, sandarach, lac, benzoin, copal, amber, and asphaltum. The menstrua are either expressed or essential oils, as also alcohol. For a lac varnish of the first kind, the common painter's varnish is to be united by gently boiling it with some more mastich or colophony, and then diluted again with a little more oil of turpentine. The latter addition promotes both the glossy appearance and drying of the varnish.

Of this sort is the amber varnish. To make this varnish, half a pound of amber is kept over a gentle fire in a covered iron pot, in the lid of which there is a small hole, till it is observed to become soft, and to be melted together into one mass. As soon as this is perceived, the vessel is taken from off the fire, and suffered to cool a little; when a pound of good painter's varnish is added to it, and the whole suffered to boil up again over the fire, keeping it continually stirring. After this, it is again removed from the fire; and when it is become somewhat cool, a pound of oil of turpentine is to be gradually mixed with it. Should the varnish, when it is cool, happen to be yet too thick, it may be attenuated with more oil of turpentine. This varnish has always a dark-brown colour, because the amber is previously half-burned in this operation; but if it be required of a bright colour, amber-powder must be dissolved in transparent painter's varnish, in Papin's machine, by a gentle fire.

As an instance of the second sort of lac varnishes with ethereal oils alone, may be adduced the varnish made with oil of turpentine. For making this, mastich alone is dissolved in oil of turpentine by a very gentle digesting heat, in close glass vessels. This is the varnish used for the modern transparencies employed as window-blinds, fire-screens, and for other purposes. These are commonly prints, coloured on both sides, and afterward coated with this varnish on those parts that are intended to be transparent. Sometimes fine thin calico, or Irish linen, is used for this purpose; but it requires to be primed with a solution of isinglass, before the colour is laid on.

Copal may be dissolved in genuine Chio turpentine, according to Mr. Sheldrake, by adding it in powder to the turpentine previously melted, and stirring till the whole is fused. Oil of turpentine may then be added, to dilute it sufficiently. Or the copal in powder may be put into a long-necked matrass with twelve parts of oil of turpentine, and digested several days on a sand-heat, frequently shaking it. This may be diluted with one fourth or one fifth of alcohol. Metallic vessels, or instruments, covered with two or three coats of this, and dried in an oven each time, may be washed with boiling water, or even exposed to a still greater heat, without injury to the varnish.

A varnish of the consistence of thin turpentine is obtained for aërostatic machines, by the digestion of one part of elastic gum, or caoutchouc, cut into small pieces, in thirty-two parts of rectified oil of turpentine. Previously to its being used, however, it must be passed through a linen cloth, in order that the undissolved parts may be left behind.

The third sort of lac-varnishes consists in the spirit-varnish. The most solid resins yield the most durable varnishes; but a varnish must never be expected to be harder than the resin naturally is of which it is made. Hence, it is the height of absurdity to suppose that there are any incombustible varnishes, since there is no such thing as an incombustible resin. But the most solid resins by themselves produce brittle varnishes: therefore something of a softer substance must always be mixed with them, whereby this brittleness is diminished. For this purpose, gum elemi, turpentine, or bal-

sam of capaiva, are employed in proper proportions. For the solution of these bodies the strongest alcohol ought to be used, which may very properly indeed be distilled over alkali, but must not have stood upon alkali. The utmost simplicity in composition, with respect to the number of the ingredients in a formula, is the result of the greatest skill in the art; hence it is no wonder, that the greatest part of the formulas and recipes that we meet with are composed without any principle at all.

In conformity to these rules, a fine colourless varnish may be obtained, by dissolving eight ounces of gum sandarach and two ounces of Venice turpentine in thirty-two ounces of alcohol by a gentle heat. Five ounces of shell-lac and one of turpentine, dissolved in thirty-two ounces of alcohol by a very gentle heat, give a harder varnish, but of a reddish cast. To these the solution of copal is undoubtedly preferable in many respects. This is effected by triturating an ounce of powder of gum copal, which has been well dried by a gentle heat, with a drachm of camphor, and, while these are mixing together, adding by degrees four ounces of the strongest alcohol, without any digestion.

Between this and the gold varnish there is only this difference, that some substances that communicate a yellow tinge are to be added to the latter. The most ancient description of two sorts of it, one of which was prepared with oil, and the other with alcohol, is to be found in "Alexius Pedemontanus Dei Secreti," Lucca, of which the first edition was published in the year 1557. But it is better prepared, and more durable, when made after the following prescription: Take two ounces of shell lac, of arnatto and turmeric of each one ounce, and thirty grains of fine dragon's blood, and make an extract with twenty ounces of alcohol in a gentle heat.

Oil varnishes are commonly mixed immediately with the colours, but lac or lacquer varnishes are laid on by themselves upon a burnished coloured ground: when they are intended to be laid upon naked wood, a ground should be first given them of strong size, either alone or with some earthy colour, mixed up with it by levigation. The gold lacquer is simply rubbed over brass, tin, or silver, to give them a gold colour.

Pere d'Incarville has informed us, that the tree which affords the varnish of China is called tsi-chou by the Chinese. This tree is propagated by offsets. When the cultivator is desirous of planting it, he takes a branch, which he wraps up in a mass of earth, by means of flax. Care is taken to moisten this earth; the branch pushes out roots, and is then pruned and transplanted. This tree grows to the size of a man's leg.

The varnish is drawn in spring. If it be a cultivated tree, it affords three gatherings. It is extracted by incisions made in the spring; and when the varnish, which is received in shells, does not flow, several hog's bristles, moistened with water or saliva, are introduced into the wound, and cause it to run. When the tree is exhausted, the upper part of it is wrapped in straw, which is set on fire, and causes the varnish to precipitate to the bottom of the tree, where it flows out of perforations made for that purpose.

Those who collect the varnish set out before day-break, and place their shells beneath the apertures. The shells are not left longer than three hours in their place, because the heat of the sun would evaporate the varnish.

The varnish emits a smell, which the workmen are very careful to avoid respiring. It produces an effect which they call the bud of the varnish.

When the varnish issues from the tree it resembles pitch. By exposure to the air, it gradually becomes coloured, and is, at last, of a beautiful black.

The juice which flows from incisions made in the trunk and branches of the rhus toxicodendron possesses the same properties. It is a white milky fluid, which becomes black and thick by the contact of the air.

To make the varnish bright, it is evaporated by the sun; and a body is given to it with hog's gall and sulphate of iron.

The Chinese use the oil of tea, which they render drier by boiling it with orpiment, realgar, and arsenic.

To varnish any substance, consists in applying upon its surface a covering of such a nature, as shall defend it from the influence of the air, and give it a shining appearance.

A coat of varnish ought, therefore, to possess the following properties: 1. It must exclude the action of the air; because wood and metals are varnished to defend them from decay and rust. 2. It must resist water; for otherwise the effect of the varnish could not be permanent. 3. It ought not to alter such co-

lours as are intended to be preserved by this means.

It is necessary, therefore, that a varnish should be easily extended or spread over the surface, without leaving pores or cavities; that it should not crack nor scale; and that it should resist water. Now resins are the only bodies that possess these properties.

Resins, consequently, must be used as the bases of varnish. The question which of course presents itself must be, then, how to dispose them for this use; and for this purpose they must be dissolved, as minutely divided as possible, and combined in such a manner, that the imperfections of those which might be disposed to scale may be corrected by others.

Resins may be dissolved by three agents: 1. By fixed oil. 2. By volatile oil. 3. By alcohol. And accordingly we have three kinds of varnish: the fat or oily varnish, essential varnish, and spirit varnish.

Before a resin is dissolved in a fixed oil, it is necessary to render the oil drying. For this purpose the oil is boiled with metallic oxides, in which operation the mucilage of the oil combines with the metal, while the oil itself unites with the oxygen of the oxide. To accelerate the drying of this varnish, it is necessary to add oil of turpentine.

The essential varnishes consist of a solution of resin in oil of turpentine. The varnish being applied, the essential oil flies off, and leaves the resin. This is used only for paintings.

When resins are dissolved in alcohol, the varnish dries very speedily, and is subject to crack; but this fault is corrected by adding a small quantity of turpentine to the mixture, which renders it brighter, and less brittle when dry.

The coloured resins, or gums, such as gamboge, dragon's blood, &c. are used to colour varnishes.

To give lustre to the varnish after it is laid on, it is rubbed with pounded pumice-stone and water; which being dried with a cloth, the work is afterward rubbed with an oiled rag and tripoli. The surface is, last of all, cleaned with soft linen cloths, cleared of all greasiness with powder of starch, and rubbed bright with the palm of the hand.

Varnish also signifies a sort of shining coat, wherewith potter's ware, delft-ware, china-ware, &c. are covered, which gives them a smoothness and lustre. Melted lead is generally used for the first, and smalt for the second. See Enamelling.

Varnish, among medalists, signifies the colours antique medals have acquired in the earth. The beauty which nature alone is able to give to medals, and art has never yet attained to counterfeit, enhances the value of them; that is, the colour which certain soils in which they have a long time lain tinges the metals withal; some of which are blue; others with an inimitable vermilion colour; others with a certain shining polished brown, vastly finer than Brasil figures.

VARRONIA, in botany, so named from Marcus Terentius Varro, a genus of the Pentandria Monogynia class and order. Natural order of Asperifoliæ. Boragineæ, Jussieu. Essential character: corolla five-cleft; drupe with a four-celled nut. There are nine species.

VAS, a vessel either for mechanical, chemical, culinary, or any other uses. In anatomy, all the parts which convey a fluid are called vessels, as the veins, arteries, and lymphatics.

VASA *concordiæ*, among hydraulic authors, are two vessels, so constructed as that one of them, though full of wine, will not run a drop, unless the other, being full of water, do run also.

VASE, a term frequently used for ancient vessels dug from under ground, or otherwise found, and preserved in the cabinets of the curious. In architecture, the appellation vase is also given to those ornaments placed on corniches, sochles or pedestals, representing the vessels of the ancients, particularly those used in sacrifice; as incense pots, flower-pots, &c. They serve to crown or finish facades, or frontispieces; and hence called acroteria. The term vase, however, is more particularly used in architecture to signify the body of the Corinthian and Composite capital; otherwise called the tambour or drum, and sometimes the campana or bell.

VATERIA, in botany, so named from Abraham Vater, professor of medicine and botany at Witteberg, a genus of the Polyandria Monogynia class and order. Natural order of Guttiferæ, Jussieu. Essential character: calyx five-cleft; corolla five-petalled; capsule three-valved, one-celled, three seeded. There is only one species; *viz.* V. indica.

VATICA, in botany, a genus of the Dodecandria Monogynia class and order. Natural order of Guttiferæ, Jussieu. Essential character: calyx five-cleft; petals five; anthers fifteen, sessile, four-celled.

There is but one species, *viz.* V chinensis, a very rare plant, and as yet scarcely known.

VATICAN, a magnificent palace of the Pope, in Rome, which is said to consist of several thousand rooms; but the parts of it most admired are, the grand staircase, the Pope's apartment, and especially the library, which is one of the richest in the world, both in printed books and manuscripts.

VAULT, in architecture, an arched roof, so contrived that the stones which form it sustain each other. Vaults are, on many occasions, to be preferred to soffits, or flat ceilings, as they give a greater height and elevation, and are besides more firm and durable.

VECTOR, or *Radius Vector*, in astronomy, is a line supposed to be drawn from any planet moving round a centre, or the focus of an ellipse, to that centre, or focus. It is so called, because it is that line by which the planet seems to be carried round its centre; and with which it describes areas proportional to the times.

VEER, a sea term, variously used. Thus veering out a rope, denotes the letting it go by hand, or letting it run out of itself. It is not used for letting out any running rope except the sheet.

VEGETABLE. See BOTANY, PLANT, &c. A vegetable is composed of a root, stem, leaves, flowers, fruits, and seeds; and when all these different parts are fully developed, the vegetable is said to be perfect. When any are deficient, or at least less obvious, the vegetable is said to be imperfect. The root is that part of the plant which is concealed in the earth, and which serves to convey nourishment to the whole plant. The stem, which commences at the termination of the root, supports all the other parts of the plant. When the stem is large and solid, as in trees, it is denominated the trunk, which is divided into the wood and the bark. The bark constitutes the outermost part of the tree, and covers the whole of the plant from the extremity of the roots to the termination of the branches. The bark is composed of three parts, namely, the epidermis, the parenchyma, and cortical layers. The epidermis, which is a thin transparent membrane, forming the external covering of the bark, is composed of fibres crossing each other. When the epidermis is removed, it is reproduced. The parenchyma, which is immediately below the epidermis, is of a dark-green colour, composed of fibres crossing each other in all directions, and is succulent and tender.

The cortical layers which constitute the interior part of the bark are composed of thin membranes, and increase in number with the age of the plant. The wood immediately under the bark is composed of concentric layers, which increase with the age of the plant, and may be separated into thinner layers, which are composed of longitudinal fibres. The wood next the bark, which is softer and whiter, is called the alburnum. The interior part of the trunk is browner and harder, and is denominated the perfect wood.

In the middle of the stem is the pith, which is a soft, spongy substance, composed of cells. In old wood this part entirely disappears, and its place is occupied by the perfect wood.

The leaves are composed of fibres arranged in the form of net-work, which proceed from the stem and footstalk, by which they are attached to the branches. These fibres form two layers in each leaf, which are destined to perform different functions. The leaves are covered with the epidermis, which is common to the whole of the plant. Each surface of a leaf has a great number of pores and glands, which absorb or emit elastic fluids.

Flowers are composed of different parts. The calyx or cup is formed by the extension of the epidermis; the corolla is a continuation of the bark, and the stamina and pistilla, the internal parts of fructification, are composed of the woody fibres and pith of the plant. Fruits are usually composed of a pulpy, parenchymatous substance, containing a great number of vesicles, and traversed by numerous vessels. Seeds are constituted of the same utricular texture, in the vesicles of which is deposited a pulverulent or mucous substance. These cells have a communication with the plants by means of vessels, and by these is conveyed the necessary nourishment during germination.

Plants contain different orders of vessels, which are distinguished from each other by their course, situation, and uses. Lymphatic vessels serve for the circulation of the sap. They are chiefly situated in the woody part of the plant. The peculiar vessels which generally contain thick or coloured fluids, are placed immediately under the bark; they are smaller in number than the sap vessels, and have thin interstices filled up with utriculi or cells, with which they form a communi-

cation. Some of these proper vessels are situated between the epidermis and the bark, which are readily detected in the spring. Some are situated in the interior part of the bark, forming oval rings, and filled with the peculiar juices of the plant. Another set of proper vessels is placed in the alburnum, nearer the centre of the stock or trunk, and sometimes in the perfect wood. The utriculi or cells constitute another set of vessels, which seem to resemble a flexible tube, slightly interrupted with ligatures at nearly equal distances, but still preserving a free communication through its whole length. They vary in form, colour, and magnitude, in different vegetables, and exist in the roots, the bark, leaves, and flowers. The trachea, or spiral vessels, which are readily detected in succulent plants, appear in the form of fine threads, and may be drawn out to a considerable length without breaking. These vessels are very numerous in all plants, especially under the bark, where they form a kind of ring, and are disposed in distinct bundles, in trees, shrubs, and stalks of herbaceous plants.

Vegetable *acids*, in chemistry. The acids which exist in many vegetables are at once recognized by their taste. These acids were formerly denominated essential salts of vegetables, and it was supposed, that all essential salts were the same, and were composed of tartar, or vinegar. But Scheele's discovery of the citric, malic, and gallic acids, which possessing distinct properties from those of tartaric and acetic acids, proved the contrary. Some vegetables contain only one acid, as oranges and lemons, which contain citric acid only. In other vegetables two acids are found, as in gooseberries and currants, the malic and citric acids; and sometimes three, as the tartric, citric, and malic acids, which exist together in the pulp of the tamarind. As the acids which exist in vegetables have been already described, under their respective heads, it is now only necessary to enumerate the vegetable acids, specifying at the same time some of the plants from which they are obtained.

Acetic acid has been discovered in the sap of some trees, and in the acid juice of cicer arictinum. Oxalic acid exists in combination with potash, in the leaves of the oxalis acetosella, or wood-sorrel. In other species belonging to the same genus, and in some species of rumex, it is in the state of accidulous oxalate of potash. Oxalate of lime has been found in the root of rhubarb. Citric acid is found in the juice of oranges and lemons, in the berries of two species of vaccinium, &c. Malic acid exists unmixed with other acids, in the apple, the barberry, plum, sloe, elder, &c. In the gooseberry, in the cherry, strawberry, currants, and some other fruits, malic and citric acids are found nearly in equal proportions. Malic acid has been found mixed with tartaric acid in the agave Americana, and in the pulp of tamarinds, along with citric acid. Vauquelin found it combined with lime, forming a malate of lime, in the sempervivum tectorum, or house-leek. Gallic acid is found in a great number of plants and in them it exists chiefly in the bark. Benzoic acid is found in benzoin, balsam of Tolu and Peru, liquid styrax, cinnamon, and vanilla. Fourcroy and Vauquelin suspect that it exists in the anthoxanthum odoratum, or sweet-scented grass, which communicates the aromatic flavour to hay. Prussic acid has been found in the leaves of the lauro-cerasus and peach, in bitter almonds, in the kernels of apricots; and it is supposed that it exists also in the kernels of peaches, of plums, and cherries. It is obtained from the kernels of apricots, by distilling water off them with a moderate heat; and if lime be added to the concentrated infusion of bitter almonds, a prussiate of lime is formed. Phosphoric acid has been found in different parts of plants; but it is generally combined with lime, forming a phosphate of lime.

VEIN, in anatomy, is a vessel which carries the blood from the several parts of the body to the heart. The veins are composed principally of a membranaceous a vasculous, and a musculous tunic: but these are vastly thinner than in the arteries. See Artery.

VELESIA, in botany, so named from Christoval Velesius, examiner, first physician, and demonstrator of botany, in the College of Apothecaries at Madrid, a genus of the Pentandria Digynia class and order. Natural order of Caryophyllei. Caryophylleæ, Jussieu. Essential character: calyx filiform, five-toothed; corolla five-petalled, small; capsule one-celled; seeds numerous, in a single row. There is but one species, *viz*. V. rigida, a native of the South of Europe.

VELLA, in botany, a genus of the Tetradynamia Siliculosa class and order. Natural order of Siliquosa or Cruciformes. Cruciferæ, Jussieu. Essential character: silicle with a partition twice as large as the valves, ovate on the outside. There

are two species, *viz.* V. annua, annual vella or cress rocket; and V. pseudo cytisus, shrubby vella.

VELOCITY, swiftness, or that affection of motion whereby a moving body is disposed to run over a certain space in a certain time.

In the doctrine of fluxions it is usual to consider the velocity with which magnitudes flow, or are generated. Thus, the velocity with which a line flows, is the same as that of the point, which is supposed to describe or generate the line. The velocity with which a surface flows, is the same as the velocity of a given right line, that, by moving parallel to itself, is supposed to generate a rectangle, always equal to the surface. The velocity with which a solid flows, may be measured by the velocity of a given plain surface, that, by moving parallel to itself, is supposed to generate an erect prism, or cylinder, always equal to the solid. The velocity with which an angle flows, is measured by the velocity of a point, supposed to describe the arc of a given circle, which subtends the angle, and measures it. All these velocities are measured at any term of the time of the motion, by the spaces which would be described in a given time by these points, lines, or surfaces, with their motions continued uniformly from that term. The velocity with which a quantity flows, at any term of the time while it is supposed to be generated, is called its fluxion. See FLUXIONS.

VELOCITY *of bodies moving in curves.* According to Galileo's system of the fall of heavy bodies, which is now universally admitted among philosophers, the velocities of a body falling vertically are, at each moment of its fall, as the square roots of the heights from whence it has fallen; reckoning from the beginning of the descent. And hence he inferred, that if a body descend along an inclined plane, the velocities it has, at the different times, will be in the same ratio: for since its velocity is all owing to its fall, and it only falls as much as there is perpendicular height in the inclined plane, the velocity should be still measured by that height, the same as if the fall were vertical. The same principle led him also to conclude, that if a body fall through several contiguous inclined planes, making any angles with each other, much like a stick when broken, the velocity would still be regulated after the same manner, by the vertical heights of the different planes taken together, considering the last velocity as the same that the body would acquire by a fall through the same perpendicular height.

This conclusion continued to be acquiesced in till the year 1672, when it was demonstrated to be false, by James Gregory, who shows what the real velocity is, which a body acquires by descending down two contiguous inclined planes, forming an obtuse angle, and that it is different from the velocity which a body acquires by descending perpendicularly through the same height; also that the velocity in quitting the first plane, is to that with which it enters the second, and in this latter direction, as radius to the cosine of the angle of inclination between the two planes.

This conclusion, however, it is observed, does not apply to the motions of descent down any curve lines, because the contiguous parts of curve lines do not form any angle between them, and consequently no part of the velocity is lost by passing from one part of the curve to the other; and hence he infers, that the velocities acquired in descending down a continued curve line, are the same as by falling perpendicularly through the same height. This principle is then applied, by the author, to the motion of pendulums and projectiles.

Varignon too, in the year 1693, followed in the same track, showing that the velocity lost in passing from one right lined direction to another, becomes indefinitely small in the course of a curve line; and that therefore the doctrine of Galileo holds good for the descent of bodies down a curve line, *viz.* that the velocity acquired at any point of the curve, is equal to that which would be acquired by a fall through the same perpendicular altitude.

VELVET, a rich kind of stuff, all silk, covered on the outside with a close, short, fine, soft shag, the other side being a very strong close tissue. The nap, or shag, called also the velveting, of this stuff, is formed of a part of the threads of the warp, which the workman puts on a long narrow-channelled ruler or needle, which he afterwards cuts, by drawing a sharp steel tool along the channel of the needle to the ends of the warp.

VENEERING, or VANEERING, a kind of inlaying, whereby several thin slices or leaves of fine woods, of different kinds, are applied and fastened on a ground of some common wood. There are two kinds of inlaying; the one which is the most common and more ordinary, goes no further than the making of compartments of

different woods; the other requires much more art, in representing flowers, birds, and the like figures. The first kind is properly called veneering; the latter is more properly called marquetry. The wood used in veneering is first sawed out into slices or leaves about a line in thickness: *i. e.* the twelfth part of an inch. In order to saw them, the blocks, or planks, are placed upright in a kind of sawing press. These slices are afterwards cut into narrow slips, and fashioned divers ways, according to the design proposed; then the joints having been exactly and nicely adjusted, and the pieces brought down to their proper thickness, with several planes for the purpose, they are glued down on a ground or block, with good strong glue. The pieces being thus joined and glued, the work, if small, is put in a press; if large, it is laid on a bench covered with a board, and pressed down with poles on pieces of wood, one end of which reaches to the ceiling of the room, and the other bears on theboard. When the glue is thoroughly dry, it is taken out of the press and finished; first with little planes, then with divers scrapers, some of which resemble rasps, which take off the dents, &c. left by the planes. After it has been sufficiently scraped, they polish it with the skin of a sea-dog, wax, and a brush, or polisher, of shave grass; which is the last operation.

VENTER, is used in the law for the children by a woman of one marriage. There is a first and second venter, &c. where a man hath children by several wives.

VENTILAGO, in botany, a genus of the Pentandria Monogynia class and order. Essential character: calyx tubular; corolla scales protecting the stamens, which are inserted into the calyx; samara winged at the top, and one seeded. There is only one species, *viz.* V. maderaspatana.

VENTILATOR, a machine by which the noxious air of any close place, as an hospital, jail, ship, chamber, &c. may be changed for fresh air.

VENTRE *inspiciendo*, a writ to search a woman that saith she is with child, and thereby withholds lands from the next heir. As if a man, having lands in fee-simple, die, and his widow soon after marry again, and say she is with child by her former husband; in this case, this writ *de ventre inspiciendo* lies for the heir against her; by which writ the sheriff is commanded, that in presence of twelve men, and as many women, he cause examination to be made, whether the woman is with child or not; and if with child, then about what time it will be born; and that he certify the same to the justices of the assize, or at Westminster, under his seal, and under the seals of two of the men present. Cro. Elizabeth, 506. This writ is now granted, not only to an heir at law, but to a devisee, whether for life, in tail, or in fee.

VENTRILOQUISM, an art of speaking, by means of which the human voice and other sounds are rendered audible, as if they proceeded from various different places; though the utterer does not change his place, and in many instances does not appear to speak. It has been supposed to be a natural peculiarity, because few, if any, persons have learned it by being taught; and we have had no rules laid down for acquiring it. It seems to have been in consequence of this notion, that the name ventriloquism has been applied to it, from a supposition that the voice proceeds from the thorax or chest. It has seldom been practised but by persons of the lower classes of society; and as it does not seem to present any advantages beyond that of causing surprize and entertainment, and cannot be exhibited on an extended theatre, the probability is that it will continue amongst them.

Mr. Gough, in the Manchester Memoirs, and in various parts of Nicholson's Journal, has entertained the opinion, that the voice of ventriloquists is made to proceed, in appearance, from different parts of a room by the management of an echo. But the facts themselves do not support this hypothesis, as a great and sudden variety and change of echoes would be required; and his own judicious remarks, in the same work, on the facility with which we are deceived as to the direction of sound, are adverse to his theory. From numerous attentive observations, it appears manifest that the art is not peculiar to certain individuals, but may with facility be acquired by any person of accurate observation. It consists merely in an imitation of sounds, as they occur in nature, accompanied with appropriate action, of such a description as may best concur in leading the minds of the observers to favour the deception.

Any one who shall try, will be a little surprised to find how easy it is to imitate the noise made by a saw, or by a snuff-box when opened or shut, or by a large hand-bell, or a cork-cutter's knife, a watch while going, and numberless other inanimate objects; or the voices of ani-

mals in their various situations and necessities, such as a cat, a dog, or an hen enraged, intimidated, confined, &c.; or to vary the character of the human voice by shrillness or depth of tone, rapidity or drawling of execution, and distinctness or imperfection of articulating, which may be instantly changed by holding the mouth a little more open or more closed than usual, altering the position of the jaw, keeping the tongue in any determinate situation, &c. And every one of the imitations of the ventriloquists will be rendered more perfect by practising them at the very time the sounds are heard, instead of depending on the memory. The leading condition of performance is, that the voices and sounds of the dramatic dialogue to be exhibited, should succeed each other so rapidly that the audience should lose sight of the probability that one actor gives effect to the whole, and that where the business is simple, the aid of scenery or local circumstance should be called in.

We have seen an eminent philosopher of our own time, who had no previous practice of this art, but when speaking on the subject in a mixed company, took up an hat, and folding the flaps together said, by way of example, "Suppose I had a small monkey in this hat;" and then cautiously putting his hand in, as if to catch it, he imitated the chatter of the supposed struggling animal, at the same time that his own efforts to secure it had a momentary impression on the spectators, which left no time for them to question whether there was a monkey in it or not: this impression was completed, when, the instant afterwards, he pulled out his hand as if hurt, and exclaimed "he has bit me." It was not till then that the impression of reality gave way to the diversion arising from the mimic art; and one of the company, even then, cried out, "Is there really a monkey in the hat?"

In this manner it was that, at the beginning of the last century, the famous Tom King, who is said to have been the first man who gave public lectures on experimental philosophy in this country, was attended by the whole fashionable world, for a succession of many nights, to hear him "kill a calf." This performance was done in a separate part of the place of exhibition, into which the exhibitor retired alone; and the imagination of his polite hearers was taxed to supply the calf and three butchers, besides a dog who sometimes raised his voice, and was checked for his unnecessary exertions. It appears, from traditional narrative, that the calf was heard to be dragged in, not without some efforts and conversation on the part of the butchers, and noisy resistance from the calf; that they conversed on the qualities of the animal, and the profits to be expected from the veal; and that, as they proceeded, all the noises of knife and steel, of suspending the creature, and of the last fatal catastrophe, were heard in rapid succession, to the never-failing satisfaction of the attendants; who, upon the rise of the curtain, saw that all these imaginary personages had vanished, and Tom King alone remained to claim the applause.

A similar fact may be quoted in the person of that facetious gentleman who has assumed and given celebrity to the name of Peter Pindar. This great poet, laughing at the proverbial poverty of his profession, is sometimes pleased to entertain his friends with unexpected effusions of the art we speak of. One of these is managed by a messenger announcing to the Doctor (in the midst of company) that a person wants to speak with him; he accordingly goes out, leaving the door a-jar, and immediately a female voice is heard, which, from the nature of the subject, appears to be that of the Poet's laundress, who complains of her pressing wants, disappointed claims, and of broken promises, no longer to be borne with patience. It is more easy to imagine than describe the mixed emotions of the audience. The scene, however, goes on by the Doctor's reply, who remonstrates, promises, and is rather angry at the time and place of this unwelcome visit. His antagonist unfortunately is neither mollified nor disposed to quit her ground. Passion increases on both sides, and the Doctor forgets himself so far as to threaten the irritated female; she defies him, and this last promise; very unlike the former ones, is followed by payment; a severe slap on the face is heard; the poor woman falls down stairs, with horrid outcries; the company, of course, rises in alarm, and the Doctor is found in a state of perfect tranquillity, apparently a stranger to the whole transaction.

A very able ventriloquist, Fitz James, performed in public, in Soho Square, about four years ago. He personated various characters by appropriate dresses;

and by a command of the muscles of the face he could very much alter his appearance. He imitated many inanimate noises, and among others, the repetition of noises of the water-machine at Marli. He conversed with some statues, which replied to him; and also with some persons supposed to be in the room above, and on the landing place; gave the watchman's cry, gradually approaching, and when he seemed opposite the window, Fitz-James opened it, and asked what the time was, received the answer, and during the proceeding with his cry, Fitz-James shut the window, immediately upon which the sound became weaker, and at last insensible. In the whole of his performance it was clear that the notions of the audience were governed by the auxiliary circumstances, as to direction, &c. This mimic had, at least, six different habitual modes of speaking, which he could instantly adopt one after the other, and with so much rapidity, that when in a small closet, parted off in the room, he gave a long, confused, and impassioned debate of Democrats (in French, as almost the whole of his performance was); it seemed to proceed from a multitude of speakers: and an inaccurate observer might have thought that several were speaking at once. A ludicrous scene of drawing a tooth was performed in the same manner.

These examples, and many more which might be added, are sufficient, in proof, that ventriloquism is the art of mimicry, an imitation applied to sounds of every description, and attended with circumstances which produce an entertaining deception, and lead the hearers to imagine that the voice proceeds from different situations. When distant, and consequently low voices are to be imitated, the articulation may be given with sufficient distinctness, without moving the lips or altering the countenance. It was by a supposed supernatural voice of this kind, from a ventriloquist, that the famous musical small-coal man, Thomas Britton, received a warning of his death, which so greatly affected him that he did not survive the affright.

VENUE, the neighbourhood from whence juries are to be summoned for trial of causes. In local actions, as of trespass and ejectment, the venue is to be from the neighbourhood of the place, where the lands in question lie; and in real actions the venue must be laid in the county where the thing is for which the action is brought; but in transitory actions, for injuries that may have happened any where, as debt, detinue, slander, or the like, the plaintive may declare in what county he pleases, and then the trial must be in that county in which the declaration is laid. Though if the defendant will make affidavit that the cause of action, if any, arose not in that, but in another county, the court will direct a change of the venue, and oblige the plaintiff to declare in the proper county. And the court will sometimes move the venue from the proper jurisdiction (especially of the narrow and limited kind), upon a suggestion duly supported, that a fair and impartial trial cannot be had therein. With respect to criminal cases, it is ordained by statute 21 James I. c 4, that all informations on penal statutes shall be laid in the counties where the offences were committed.

VENUS, the most beautiful star in the heavens, known by the names of the morning and evening star, likewise keeps near the sun, though she recedes from him almost double the distance of Mercury. She is never seen in the eastern quarter of the heavens when the sun is in the western; but always seems to attend him in the evening, or to give notice of his approach in the morning. The planet Venus presents the same phenomena with Mercury: but her different phases are much more sensible, her oscillations wider, and of longer duration. Her greatest distance from the sun varies from 45° to nearly 48°, and the mean duration of a complete oscillation is 584 days. Venus has been sometimes seen moving across the sun's disc in the form of a round black spot, with an apparent diameter of about 59″. A few days after this has been observed, Venus is seen in the morning, west of the sun, in the form of a fine crescent, with the convexity turned toward the sun. She moves gradually westward with a retarded motion, and the crescent becomes more full. In about ten weeks she has moved 46° west of the sun, and is now a semicircle, and her diameter is 26.′ She is now stationary. She then moves eastward, with a motion gradually accelerated, and overtakes the sun about 9½ months after having been seen on his disc. Some time after she is seen in the evening, east of the sun, round, but very small. She moves eastward, and increases in diameter, but loses of her roundness, till she gets about 46° east of the sun, when she is again a semicircle. She now moves westward, increasing in diameter, but becoming a

crescent like the waning moon; and, at last, after a period of nearly 584 days, comes again into conjunction with the sun with an apparent diameter of 59″. She does not move exactly in the plane of the ecliptic, but deviates from it several degrees. Like Mercury, she sometimes crosses the sun's disc. The duration of these transits, as observed from different parts of the earth's surface, are very different: this is owing to the parallax of Venus, in consequence of which different observers refer to different parts of the sun's disc, and see her describe different chords on that disc. In the transit which happened in 1769, the difference of its duration, as observed at Otaheite and at Wardhuys in Lapland, amounted to 23 minutes, 10 seconds. This difference gives us the parallax of Venus, and of course her distance from the earth during a conjunction. The knowledge of this parallax enables us, by a method to be afterwards described, to ascertain that of the sun, and consequently to discover its distance from the earth. The great variations of the apparent diameter of Venus demonstrate that her distance from the earth is exceedingly variable. It is largest when the planet passes over the surface of the sun. Her mean apparent diameter is 58″.

Venus, as we have already observed, is occasionally seen in the disc of the sun, in form of a dark round spot. This happens when the earth is about her nodes at the time of her inferior conjunction. These appearances, called transits, happen but very seldom. During the last century there were two transits, one in June, 1761, and the other in 1769: no other will occur till the writers and most of the present readers of this Dictionary shall be no more, *viz.* in 1874. Excepting such transits as these, Venus exhibits the same appearances to us regularly every eight years; her conjunctions, elongations, and times of rising and setting being very nearly the same, on the same days, as before. From the transit of Venus in 1761 was deduced the sun's parallax, and of course his distance from the earth with very great accuracy. See Philosophical Transactions, vol. li. and lii. On the day of the transit, when the sun was nearly at his greatest distance from the earth, the parallax was found to be 8″ 52‴; therefore, at his mean distance it will be 8″ 65‴. Whence, by logarithms, we have 10,000, &c.—5.622 (sine of 8″ 65‴)= 4.376=23882.84, the number of semi-diameters of the earth contained in its distance from the sun. This last number, multiplied by 3985, the number of miles in the earth's semi-diameter, gives 95,173-122 miles for the mean distance of the earth from the sun. This being obtained, we easily, by calculation, find the distances of all the other planets. Other observers made the parallax somewhat different, but it was generally admitted that this distance is somewhere between 95 and 96 millions of miles.

Venus, in natural history, a genus of the Vermes Testacea class and order. Animal a tethys; shell bivalve, the frontal margin flattened with incumbent lips; hinge with three teeth, all of them approximate, the lateral ones divergent at the tip. There are nearly two hundred species, in sections. A. Shell somewhat heart-shaped. B. Orbicular. These are found in different parts of the world. V. verrucosa inhabits the Mediterranean, English, and Antilly coasts: thick, two inches long, and as much broad; sometimes marked with a few brown spots and rays. V. mercenaria, or clam, is the species which abounds in the bays of the United States; is edible, and is brought to market in great quantities.

VERATRUM, in botany, a genus of the Polygamia Monoecia class and order. Natural order of Coronariæ. Junci, Jussieu. Essential character: calyx none; corolla six-petalled; stamina six: hermaphrodite, pistils three; capsule many-seeded: male, rudiment of a pistil. There are four species.

VERB. See Grammar.

VERBASCUM, in botany, *mullien*, a genus of the Pentandria Monogynia class and order. Natural order of Luridæ. Solaneæ, Jussieu. Essential character: corolla wheel-shaped, a little unequal; capsule two-celled, two-valved. There are nineteen species.

VERBENA, in botany, *vervain*, a genus of the Diandria Monogynia class and order. Natural order of Personatæ. Vitices, Jussieu. Essential character: corolla funnel-shaped, almost equal, curved; calyx one of the teeth truncate; seeds two or four, naked, or very thinly arilled; stamina two or four. There are twenty-three species.

VERBESINA, in botany, a genus of the Syngenesia Polygamia Superflua class and order. Natural order of Compositæ Oppositifoliæ. Corymbiferæ, Jussieu. Essential character: calyx a double row; florets of the ray about five; pappus awned; receptacle chaffy. There are twelve species.

VERDICT, the answer of a jury made upon any cause, civil or criminal, committed by the court to their examination; and this is two-fold, general or special. A general verdict is that which is given or brought into the court in like general terms to the general issue; as, guilty or not guilty generally. A special verdict is, when they say at large that such a thing they find to be done by the defendant, or tenant, so declaring the course of the fact, as in their opinion it is proved; and as to the law upon the fact, they pray the judgment of the court: and this special verdict, if it contain any ample declaration of the cause from the beginning to the end, is also called a verdict at large. A special verdict is usually found where there is any difficulty or doubt, respecting the laws, when the jury state the facts as proved, and pray the advice of the court thereon. A less expensive and more speedy mode, however, is to find a verdict generally for the plaintiff, subject, nevertheless to the opinion of the judge, or the court above, or a special case drawn up and settled by counsel on both sides.

VERDITER, a kind of mineral substance, sometimes used by the painters, &c. for a blue; but more usually mixed with a yellow for a green colour.

VERDOY, in heraldry, denotes a bordure of a coat of arms, charged with any kinds or parts of flowers, fruits, seeds, plants, &c.

VERGE, signifies the compass of the King's court, which bounds the jurisdiction of the Lord Steward of the Household; and which is thought to have been twelve miles round.

The term verge is also used for a stick or rod, whereby one is admitted tenant to a copyhold estate, by holding it in his hand, and swearing fealty to the lord of the manor.

VERGERS, certain officers of the courts of King's Bench and Common Pleas, whose business it is to carry white wands before the judges.

There are also vergers of cathedrals and collegiate churches, who carry a rod tipped with silver before the bishop, dean, &c.

VERGETTE, in heraldry, denotes a pallet, or small pale; and hence a shield, divided by such pallets, is termed vergette.

VERJUICE, a liquor obtained from grapes or apples, unfit for wine or cyder; or from sweet ones, whilst yet acid and unripe. Its chief use is in sauces, ragouts, &c. though it is also an ingredient in some medicinal compositions, and is used by the wax-chandlers to purify their wax.

VERMES, in natural history, the last class of the animal kingdom, according to the Linnæan system. The animals in this class are not merely those commonly known by the name of worms, but likewise those which have the general character of being "slow in motion, of a soft substance, extremely tenacious of life, capable of re-producing such parts of their body as may have been taken away or destroyed, and inhabiting moist places." There are five orders in this class, *viz.* the

Infusoria	Testacea
Intestina	Zoophyta
Mollusca	

These animals are generally considered as the lowest in the scale of animated being. The simplicity of their form, the humility of their station, and the low degree of sense and motion which they seem to enjoy, have rendered them objects of but little attention to mankind in general, excepting as they contribute to the supply of their wants, or to render themselves formidable, by the pain and distress which they occasion to those bodies which nature seems to have destined for their habitation. But, to the curious investigator of the ways of heaven, every part of the vast creation becomes interesting, and this class of animated beings has, in later times, attracted a considerable share of attention. To this they seem fully entitled, if we consider the number of animals which are included under the general name of worms; if we observe the simplicity of form in some of them, and the complicated structure of others; in short, if we reflect on the various modes in which they are propagated, and on the surprising faculty, which many of them possess, of spontaneous reproduction; the imagination will be astonished with their number and variety, and confounded by their wonderful properties. The waters are peopled with myriads of animated beings, which, though invisible to our unassisted eyes, are unquestionably endowed with organs as perfect as the largest animals, since, like these, they re-produce others similar to themselves, and hold in the scale of nature a rank as little equivocal, though less obvious and obtrusive. The elegance of form, and beauty of colour, which some of the "mollusca," and "zoophyta" possess, cannot fail to render them

objects of admiration to the most indifferent observer.

VERMICELLI, a composition of flour, cheese, yolks of eggs, sugar, and saffron, reduced to a paste, and formed into long slender pieces, like worms, by forcing it with a piston through a number of little holes.

VERNIER, a scale adapted for the graduation of mathematical instruments, so called from Pierre Vernier the inventor. Under the article BAROMETER will be seen some account of this scale as applied to that instrument; here we shall take it up more generally.

This scale is derived from the following principle. If two equal right lines, or circular arcs, A B, are so divided, that the number of equal divisions in B is one less than the number of equal divisions in A then will the excess of one division of A, be compounded of the ratios of one of A to A, and of one of B to B. For let A contain 11 parts, then one of A to A is as 1 to 11, or $\frac{1}{11}$. Let B contain 10 parts, then one of B to B is as 1 to 10, or $\frac{1}{10}$. Now $\frac{1}{10}-\frac{1}{11}=\frac{11-10}{10\times 11}=\frac{1}{10\times 11}=\frac{1}{10}\times\frac{1}{11}$.

Or if B contains n parts, and A contains $n+1$ parts; then $\frac{1}{n}$ is one part of B, and $\frac{1}{n+n}$ is one part of A. And $\frac{1}{n}-\frac{1}{n+1}=\frac{n+1-n}{n\times \overline{n+1}}=\frac{1}{n}\times\frac{1}{n+1}$.

The most commodious divisions, and their aliquot parts, into which the degrees on the circular limb of an instrument may be supposed to be divided, depend on the radius of that instrument.

Let R be the radius of a circle in inches; and a degree to be divided into n parts, each being $\frac{1}{p}$th part of an inch

Now the circumference of a circle, in parts of its diameter 2 R inches, is 3.1415926 $\times$ 2 R inches.

Then $360° : 3.1415926 \times 2\,R :: 1° : \frac{3.1415926}{300} \times 2\,R$ inches.

Or, $0.01745329 \times R$ is the length of one degree in inches.

Or, $0.01745329 \times R \times p$ is the length of 1°, in pth parts of an inch.

But as every degree contains n times such parts, therefore $n = 0.01745329 \times R \times p$.

The most commodious perceptible division is $\frac{1}{8}$ or $\frac{1}{10}$ of an inch.

Example. Suppose an instrument of 30 inches radius, into how many convenient parts may each degree be divided? how many of these parts are to go to the breadth of the vernier, and to what parts of a degree may an observation be made by that instrument?

Now, $0.01745 \times R = 0.5236$ inches, the length of each degree: and if p is supposed about $\frac{1}{8}$ of an inch for one division; then $0.5236 \times p = 4.188$ shows the number of such parts in a degree. But as this number must be an integer, let it be 4, each being 15′; and let the breadth of the vernier contain 31 of those parts, or $7\frac{3}{4}$°, and be divided into 30 parts.

Here $n = \frac{1}{4}$; $m=\frac{1}{30}$; then $\frac{1}{4}\times\frac{1}{30}=\frac{1}{120}$ of a degree, or 30′, which is the least part of a degree that instrument can show.

If $n=\frac{1}{5}$, and $m=\frac{1}{36}$; then $\frac{1}{5}\times\frac{1}{36}=\frac{60}{5\times 36}$ of a minute, or 20″.

VERONICA, in botany, *speedwell*, a genus of the Diandria Monogynia class and order. Natural order of Personatæ. Pediculares, Jussieu. Essential character: corolla four-cleft, wheel-shaped, with the lowest segment narrower; capsule superior, two-celled. There are fifty-seven species.

VERSED *sine of an arch*, a segment of the diameter of a circle, lying between the foot of a right sine, and the lower extremity of the arch.

VERT, in heraldry, the term for a green colour. It is called vert in the blazon of the coats of all under the degree of nobles; but in coats of nobility, it is called emerald; and in those of kings, Venus. In engraving, it is expressed by diagonals, or lines drawn athwart from right to left, from the dexter chief corner to the sinister base.

VERT, OR GREEN HUE, in forest law, any thing that grows and bears a green leaf within the forest, that may cover a deer. This is divided into over-vert and nether-vert; over-vert is the great woods which, in law-books, are usually called haultbois; nether-vert is the underwoods, otherwise called sub-bois. We sometimes also meet with special vert, which denotes all trees growing in the king's woods within the forest; and those which

"April 26th, in the evening, at nine o'clock, true time, I succeeded in effecting the measurement of Vesta, with the same power of 288, by means of the thirteen feet reflector, with which that of Ceres, Pallas, and Juno, had been made; and when viewed by this reflector, it also appeared exactly in the same manner. Of several illuminated discs, of 2.0 to 0.5 decimal lines, which I had before made use of for measuring the satellites of Saturn and Jupiter, the smallest disc only of 0.5 lines could be used for this purpose; by it the rounded nucleus of the planet Vesta, when the disc was at the distance of 611.0 lines from the eye, appeared almost of the same size, and I must even estimate its diameter as one-sixth smaller. If, therefore, we attend, not to the full magnitude of the projection, but the estimation just mentioned, it follows, by calculation, that the apparent diameter of the planet Vesta is only 0.488 seconds, and consequently, only half of what I have found to be the apparent diameter of the fourth satellite of Saturn. This extraordinary smallness, with such an intense, radiant, and unsteady light of a fixed star, is the more remarkable, as, according to the preliminary calculations of Dr. Gauss, there can be no doubt that this planet is found in the same region between Mars and Jupiter, in which Ceres, Pallas, and Juno, perform their revolutions round the sun; that, in close union with them, it has the same cosmological origin; and that, as a planet of such smallness and of so very intense light, it is comparatively near to the earth. This remarkable circumstance will no doubt be productive of important cosmological observations, as soon as the elements of the new planet have been sufficiently determined, and its distance from the earth ascertained by calculation."

Much of what is said of Vesta is applicable to the other small planetary bodies referred to in this article.

VESTRY, a place adjoining to a church, where the vestments of the minister are kept; also a meeting at such place, where the minister, churchwardens, and principal men of most parishes, at this day, make a parish vestry. On the Sunday before a vestry is to meet, public notice ought to be given, either in the church, or after divine service is ended, or else at the church door, as the parishioners come out, both of the calling of the meeting, and also the time and place of the assembling of it; and it is reasonable then also to declare for what business the meeting is to be held, that none may be surprised, but that all may have full time before, to consider of what is to be proposed at the meeting.

VESUVIAN, in mineralogy, a species of the Flint genus; it is of a dark olive-green, which passes into a blackish green. It occurs massive, often crystallized. Specific gravity about 3.5. Before the blow-pipe, it melts without addition, into a yellowish and faintly translucent glass. It is found among the exuviæ of Vesuvius, in a rock composed of mica, hornblende, garnet, and calx spar, which Werner imagines to constitute part of the primitive mass on which that volcanic mountain rests. It has also been found in Siberia, and in Kamtschatka. At Naples it is cut into ring stones, and is sold under various names. Two specimens have been analyzed by Klaproth; the results are as follow:

Vesuvian of Vesuvius.

Silica	35.50
Lime	33.00
Alumina	22.25
Oxide of iron	7.50
Oxide of manganese	0.25
Loss	1.50
	100.00

Vesuvian of Siberia.

Silica	42.00
Lime	34.00
Alumina	16.25
Oxide of iron	5.50
Loss	2.25
	100.00

VESUVIUS, a famous volcano, or burning mountain, situated only six miles east of the city of Naples, in Italy. See VOLCANO.

VIBRATION, in mechanics, a regular reciprocal motion of a body, as, for example, a pendulum, which, being freely suspended, swings or vibrates from side to side. Mechanical authors, instead of vibration, often use the term oscillation, especially when speaking of a body that thus swings by means of its own gravity or weight.

The vibrations of the same pendulum are all isochronal; that is, they are performed in an equal time, at least in the same latitude; for in lower latitudes they are found to be slower than in higher ones. See PENDULUM. In our latitude, a pendulum $39\frac{1}{8}$ inches long vibrates seconds, making 60 vibrations in a minute.

The vibrations of a longer pendulum take up more time than those of a shorter one, and that in the sub-duplicate ratio of the lengths, or the ratio of the square roots of the lengths. Thus, if one pendulum be 40 inches long, and another only 10 inches long, the former will be double the time of the latter in performing a vibration; for $\surd 40 : \surd 10 :: \surd 4 : \surd 1$, that is, as 2 to 1. And because the number of vibrations, made in any given time, is reciprocally as the duration of one vibration, therefore the number of such vibrations is in the reciprocal subduplicate ratio of the lengths of the pendulums.

Vibrations *of a stretched chord, or string*, arise from its elasticity; which power being in this case similar to gravity, as acting uniformly, the vibrations of a chord follow the same laws as those of pendulums. Consequently the vibrations of the same chord, equally stretched, though they be of unequal lengths, are isochronal, or are performed in equal times; and the squares of the times of vibration are to one another inversely as their tensions, or powers by which they are stretched. The vibrations of a spring, too, are proportional to the powers by which it is bent. These follow the same laws as those of the chord and pendulum; and consequently are isochronal, which is the foundation of spring-watches.

Vibrations are also used in physics, &c. and for several other regular alternate motions. Sensation, for instance, is supposed to be performed by means of the vibratory motion of the contents of the nerves, begun by external objects, and propagated to the brain. This doctrine has been particularly illustrated by Dr. Hartley, who has extended it further than any other writer, in establishing a new theory of our mental operations. The same ingenious author also applies the doctrine of vibrations to the explanation of muscular motion, which he thinks is performed in the same general manner as sensation and the perception of ideas. For a particular account of his theory, and the arguments by which it is supported, see his "Observations on Man," vol. 1.: see also Belsham's "Elements;" and "Introductory Essays to Hartley," by Dr. Priestley.

VIBRIO, in natural history, a genus of the Vermes Infusoria class and order. Worm invisible to the naked eye, very simple, round, elongated. There are twenty species, described by Adams, and other authors on the microscope.

VIBURNUM, in botany, *laurustinus*, a genus of the Pentandria Trigynia class and order. Natural order of Dumosæ. Caprifolia, Jussieu. Essential character: calyx five-parted, superior; corolla five-cleft; berry one-seeded. There are twenty three species.

VICAR, one who supplies the place of another. The priest of every parish is called rector, unless the prædial tithes are appropriated, and then he is stiled vicar; and when rectories are appropriated, vicars are to supply the rector's place. For the maintenance of the vicar, there was then set apart a certain portion of the tithes, commonly about a third part of the whole, which are now what are called the vicarial tithes, the rest being reserved to the use of those houses which, for the like reason, are termed the rectorial tithes.

VICARAGE. For the most part vicarages were endowed upon appropriations; but sometimes vicarages have been endowed without any appropriation of the parsonage; and there are several churches where the tithes are wholly impropriated, and no vicarage endowed; and there the impropriators are bound to maintain curates to perform divine service, &c. The parsons, patron, and ordinary, may create a vicarage, and endow it; and in time of vacancy of the church, the patron and ordinary may do it; but the ordinary alone cannot create a vicarage, without the patron's assent.

VICE, in smithery, and other arts employed in metals, is a machine, or instrument, serving to hold fast any thing they are at work upon, whether it is to be filed, bent, riveted, &c. To file square, it is absolutely necessary that the vice be placed perpendicular, with its chaps parallel to the work-bench.

Vice, *hand*, is a small kind of vice serving to hold the lesser works in, that require often turning about. Of these there are two kinds: the broad-chapped hand-vice, which is that commonly used; and the square-nosed hand-vice, seldom used but for filing small round work.

Vice is also a machine used by the glaziers to turn or draw lead into flat rods, with grooves on each side to receive the edges of the glass.

Vice is also used in the composition of divers words, to denote the relation of something that comes instead, or in the place of another; as vice-admiral, vice-chancellor, vice-chamberlain, vice-president, &c. are officers who take place in the absence of admirals, &c. See the article Admiral, &c.

VICIA, in botany, *vetch*, a genus of the Diadelphia Decandria class and order. Natural order of Papilionaceæ, or Leguminosæ. Essential character: stigma transversely bearded on the lower side. There are twenty-five species.

VICINAGE, in law, common of vicinage is, where the inhabitants of two townships, which lie contiguous, have usually intercommoned with one another, the beasts of the one straying mutually into the other's fields without any molestation from either. This, indeed, is only a permissive right, intended to excuse what, in strictness, is a trespass in both, and to prevent a multiplicity of suits; and therefore either township may inclose and bar out the other, though they have intercommoned time out of mind. Neither has any person of one town a right to put his beasts, originally, into the other's common; but if they escape and stray there of themselves, the law does not punish trespass.

VI ET ARMIS, *with force and arms*, in law, are words used in indictments, declarations, &c. to express the charge of forcible and violent committing any crime or trespass; but on appeal of death, on a killing with a weapon, the words *vi et armis* are not necessary, because they are implied; so in an indictment of forcible entry alleged to have been made *manu forti*, &c.

VIETA (Francis,) in biography, a very celebrated French mathematician, was born in 1540, at Fontenai, a province of France. Among other branches of learning in which he excelled, he was one of the most respectable mathematicians of the sixteenth century, or indeed of any age. His writings abound with marks of great originality, and the finest genius, as well as intense application. His application was such, that, it is said, he has sometimes remained in his study for three days together, without eating or sleeping. His inventions and improvements, in all parts of the mathematics, were very considerable. He was in a manner the inventor and introducer of specious algebra, in which letters are used instead of numbers. He made also considerable improvements in geometry and trigonometry. He gave some masterly tracts on trigonometry, both plane and spherical, which may be found in the collection of his works, published at Leyden in 1646, by Schooten, besides another large and separate volume in folio, published in the author's life time, at Paris, in 1579, containing extensive trigonometrical tables, with the construction and use of the same. To this complete treatise on trigonometry, plane and spherical, are subjoined several miscellaneous problems and observations, such as, the quadrature of the circle, the duplication of the cube, &c. Computations are here given of the ratio of the diameter of a circle to the circumference, and of the length of the sign of one minute, both to a great many places of figures; by which he found that the sine of one minute is

between	2908881959
and	2908882056

also the diameter of a circle, being 1000, &c. that the perimeter of the inscribed and circumscribed polygon of 393216 sides, will be as follows, *viz.* the

Perimeter of the inscribed polygon	31415926535
Perimeter of the circumscribed polygon . .	31415926537

and that therefore the circumference of the circle lies between those two numbers.

Vieta was also a profound decypherer, an accomplishment that proved very useful to his country. As the different parts of the Spanish monarchy lay very distant from one another, when they had occasion to communicate any secret designs, they wrote them in ciphers and unknown characters, during the disorders of the league: the cipher was composed of more than 500 different characters, which yielded their hidden contents to the penetrating genius of Vieta alone. His skill so disconcerted the Spanish councils for two years, that they published it at Rome, and other parts of Europe, that the French King had only discovered their ciphers by means of magic. He died at Paris, in the year 1603, in the sixty-third year of his age.

VIEW, in law, is generally where a real action, or an action of trespass, is brought in any of the Courts of Record at Westminster, and it shall appear to the court to be proper and necessary that the jurors should have a view, they may order special writs of *distringas* or *habeas corpora*, to issue, commanding the sheriff to have six of the first twelve of the jurors therein named, or of some greater number of them, at the place in question, &c. This is done where it is of any importance to the determination of the cause, to be acquainted with the local

situation and actual state of the place injured.

VILLAIN, or VILLEIN, in our ancient customs, denotes a man of servile and base condition, *viz.* a bondman or servant: and there were anciently two sorts of bondmen or villains in England: the one termed a villain in gross, who was immediately bound to the person of his lord and his heirs; the other a villain regardent to a manor, he being bound to his lord as a member belonging and annexed to the manor whereof the lord was owner; and he was properly a pure villain, of whom the lord took redemption to marry his daughter, and to make him free; and whom the lord might put out of his lands and tenements, goods and chattels, at his will, and beat and chastise, but not maim him.

VINCULUM, in algebra, a mark or character, either drawn over, or including, or some other way accompanying, a factor, divisor, dividend, &c. when it is compounded of several letters, quantities, or terms, to connect them together as one quantity, and show that they are to be multiplied, or divided, &c. together. Vieta first used the bar or line over the quantities for a vinculum, thus $\overline{a+b}$; and Albert Girard the parenthesis, thus $(a+b)$; the former way being now chiefly used by the English, and the latter by most other Europeans. Thus $\overline{a+b} \times c$, or $(a+b) \times c$, denotes the product of c and the sum $a+b$ considered as one quantity. Also $\sqrt{a+b}$, or $\sqrt{(a+b)}$, denotes the square root of the sum $a+b$. Sometimes the mark : is set before a compound factor, as a vinculum, especially when it is very long, or an infinite series: thus $3a \times : 1 - 2x + 3x^2 - 4x^3 + 5x^5$, &c.

VINE. See VITIS.

VINCA, in botany, *periwinkle*, a genus of the Pentandria Monogynia class and order. Natural order of Contortæ. Apocineæ, Jussieu. Essential character: contorted; follicles two, erect; seeds naked. There are five species.

VINEGAR is a liquor of an agreeable smell, a pleasant and strongly acid taste, and of a hue varying from light-red to brown-straw colour; and is prepared by fermenting any substance or compound which has already undergone the spirituous fermentation. Vinegar, therefore, may be made immediately from any wine, malt liquor, cyder, &c.; or from the juice of the grape and other fruits; from infusion of malt, or any saccharine liquid, through the intermedium of vinous fermentation. Both these methods are actually practised with complete success. To make vinegar out of a liquor containing suitable materials, it is only necessary, 1st, to allow some access of air to the vessel in which it is kept; and 2d to keep it in a temperature rather higher than that of the atmosphere in this climate, that is to say, about 75° to 80°. It is also almost essential, where a liquor already fermented is employed, to add a portion of yeast, or any other ferment; for though any fermented liquor, if kept in a moderate temperature in an open vessel, will spontaneously run sour, or become changed to vinegar; this change is too gradual to produce this acid in perfection, and the first acetified portion turns mouldy before the last has become sour: but where the substance employed has not yet undergone fermentation, the whole process of the vinous and subsequent acetous fermentation will go on uninterruptedly with the same ferment which at first set it in action, which happens, for example, in the making vinegar from malt, or from sugar and water. In this country vinegar is chiefly made from malt. The following is the usual process in London: A mash of malt and hot water is made, which, after infusion for an hour and a half, is conveyed into a cooler, a few inches deep, and thence, when sufficiently cooled, into large and deep fermenting tuns, where it is mixed with yeast, and kept in fermentation for four or five days. The liquor, (which is now a strong ale without hops) is then distributed into smaller barrels, set close together in a stoved chamber, and a moderate heat is kept up for about six weeks; during which the fermentation goes on equally and uniformly till the whole is soured. This is then emptied into common barrels, which are set in rows (often of many hundreds) in a field in the open air, the bung-hole being just covered with a tile, to keep off the wet, but to allow a free admission of air. Here the liquor remains for four or five months, according to the heat of the weather, a gentle fermentation being kept up till it becomes perfect vinegar. This is finished in the following way: Large tuns are employed, with a false bottom, on which is put a quantity of the refuse of raisins, or other fruit, left by the makers of raisin and other home-made wines, called technically rape. These rape-tuns are worked by pairs; one of them is quite filled with the vinegar from the barrels, and the other only

three-quarters full, so that the fermentation is excited more easily in the latter than the former; and every day a portion of the vinegar is laded from one to the other, till the whole is completely finished, and fit for sale. Vinegar, as well as fruit-wines, is often made in small quantity for domestic uses, and the process is by no means difficult. The materials may be either brown sugar and water alone, or sugar with raisins, currants, and especially ripe gooseberries: these should be mixed in the proportions which would give a strong wine, put into a small barrel, which it should fill about three-fourths, and the bung-hole very loosely stopped. Some yeast, or, what is better, a toast sopped in yeast, should be put in, and the barrel set in the sun in summer, or a little way from a fire in winter, and the fermentation will soon begin. This should be kept up constant, but very moderate, till the taste and smell indicate that the vinegar is complete. It should be poured off clear, and bottled carefully; and it will keep much better if it is boiled for a minute, cooled, and strained before bottling. Vinegar contains a considerable quantity of colouring extractive matter, from which it can only be freed by distillation; the process of which will be clearly understood by a reference to the article DISTILLATION. See also ACETIC *acid*. When vinegar is long kept, especially exposed to the air, it becomes muddy, acquires a mouldy, unpleasant smell, loses its clear red colour and all its properties, and finally, is changed to a slimy mucilage and water.

VIOL, in music, a stringed instrument, resembling in shape and tone the violin, of which it was the origin.

VIOLA, in botany, *violet*, a genus of the Syngenesia Monogamia class and order. Natural order of Campanaceæ. Cisti, Jussieu. Essential character: calyx five-leaved; corolla five-petalled, irregular, horned at the back; anthers cohering; capsule superior, one-celled, three-valved. There are forty-three species: some of these plants are highly esteemed, particularly the V. odorata, sweet, violet, for its fragrance; it is a native of every part of Europe, in woods, among bushes, in hedges, and on warm banks, flowering early in the spring.

VIOLIN. See MUSICAL *instruments*.

VIOLONCELLO. See MUSICAL *instruments*.

VIPER. See COLUBER.

VIRECTA, in botany, a genus of the Pentandria Monogynia class and order. Natural order of Rubiaceæ, Jussieu. Essential character: calyx five-toothed, with teeth interposed; corolla funnel-form; stigma two-parted; capsule one-celled, many-seeded, inferior. There are two species, *viz.* V. biflora, two-flowered virecta; and V. pratensis.

VIRGO, in astronomy, one of the signs or constellations of the zodiac, and the sixth according to order. It is marked thus ♍, and in Ptolemy's catalogue consists of thirty-two stars, in Tycho's of thirty-nine, and in the Britannic of eighty-nine.

VIRTUAL *focus*, in optics, is a point in the axis of a glass, where the continuation of a refracted ray melts it.

VIS, a Latin word, signifying force or power; adopted by physical writers to express divers kinds of natural powers or faculties. Vis impressa is defined, by Sir Isaac Newton, to be the action exercised on any body, to change its state, either in resisting, or moving uniformly in a right line. This force consists altogether in the action, and has no place in the body, after the action is ceased. See INERTIA, &c.

VISCUM, in botany, *misseltoe*, a genus of the Dioecia Tetandria class and order. Natural order of Aggregatæ, Linnæus. Caprifolia, Jussieu. Essential character: male, calyx four-parted; corolla none; filaments none; anthers fastened to the calyx: female, calyx four-leaved, superior; corolla none; style none; berry one-seeded; seed cordate. There are twelve species.

VISIBLE, something that is an object of sight or vision, or something whereby the eye is affected, so as to produce a sensation.

The Cartesians say that light alone is the proper object of vision. But according to Newton, colour alone is the proper object of sight; colour being that property of light by which the light itself is visible, and by which the images of opaque bodies are painted on the retina. Philosophers in general had formerly taken for granted, that the place to which the eye refers any visible object, seen by reflection or refraction, is that in which the visual ray meets a perpendicular from the object upon the reflecting or the refracting plane. That this is the case with respect to plane mirrors is universally acknowledged; and some experiments with mirrors of other forms seem to favour the same conclusion, and thus afford reason for extending the analogy to all cases of vision. If a right line be

held perpendicularly over a convex or concave mirror, its image seems to make one line with it. The same is the case with a right line held perpendicularly within water; for the part which is within the water seems to be a continuation of that which is without. But Dr. Barrow called in question this method of judging of the place of an object, and so opened a new field of inquiry and debate in this branch of science. This, with other optical investigations, he published in his Optical Lectures, first printed in 1674. According to him, we refer every point of an object to the place from which the pencils of light issue, or from which they would have issued, if no reflecting or refracting substance intervened. Pursuing this principle, Dr. Barrow proceeded to investigate the place in which the rays issuing from each of the points of an object, and that reach the eye after one reflection or refraction, meet; and he found that when the refracting surface was plane, and the refraction was made from a denser medium into a rarer, those rays would always meet in a place between the eye and a perpendicular to the point of incidence. If a convex mirror be used, the case will be the same; but if the mirror be plane, the rays will meet in the perpendicular, and beyond it, if it be concave. He also determined, according to these principles, what form the image of a right line will take when it is presented in different manners to a spherical mirror, or when it is seen through a refracting medium.

M. Bouguer adopts Barrow's general maxim, in supposing that we refer objects to the place from which the pencils of rays seemingly converge at their entrance into the pupil. But when rays issue from below the surface of a vessel of water, or any other refracting medium, he finds that there are always two different places of this seeming convergence: one of them of the rays that issue from it in the same vertical circle, and therefore fall with different degrees of obliquity upon the surface of the refracting medium; and another of those that fall upon the surface with the same degree of obliquity, entering the eye laterally with respect to one another. He says, sometimes one of these images is attended to by the mind, and sometimes the other; and different images may be observed by different persons. And he adds, that an object plunged in water affords an example of this duplicity of images.

From the principle above illustrated, several remarkable phenomena of vision may be accounted for: as—That if the distance between two visible objects be an angle that is insensible, the distant bodies will appear as if contiguous: whence, a continuous body being the result of several contiguous ones, if the distances between several visibles subtend insensible angles, they will appear one continuous body; which gives a pretty illustration of the notion of a continuum. Hence also parallel lines, and long vistas, consisting of parallel rows of trees, seem to converge more and more, the further they are extended from the eye; and the roofs and floors of long extended alleys seen, the former to descend, and the latter to ascend, and approach each other; because the apparent magnitudes of their perpendicular intervals are perpetually diminishing, while at the same time we mistake their distance. See Priestley's Light and Colours.

The mind perceives the distance of visible objects, 1st, From the different configurations of the eye, and the manner in which the rays strike the eye, and in which the image is impressed upon it. For the eye disposes itself differently, according to the different distances it is to see; *viz.* for remote objects the pupil is dilated, and the crystalline brought nearer the retina, and the whole eye is made more globous; on the contrary, for near objects, the pupil is contracted, the crystalline thrust forwards, and the eye lengthened. Again, the distance of visible objects is judged of by the angle the object makes; from the distinct or confused representation of the objects; and from the briskness or feebleness, or the rarity or density of the rays. To this it is owing, 1st, That objects which appear obscure or confused, are judged to be more remote; a principle which the painters make use of, to cause some of their figures to appear further distant than others on the same plane. 2d, To this it is likewise owing, that rooms whose walls are whitened, appear the smaller; that fields covered with snow, or white flowers, appear less than when clothed with grass; that mountains covered with snow, in the night time, appear the nearer; and that opaque bodies appear the more remote in the twilight.

The magnitude of visible objects is known chiefly by the angle contained between two rays drawn from the two extremes of the object to the centre of the eye. An object appears so large as is the angle it subtends; or bodies seen under

a greater angle, appear greater; and those under a less angle, less, &c. Hence the same thing appears greater or less, as it is nearer the eye or further off. And this is called the apparent magnitude. But to judge of the real magnitude of an object, we must consider the distance: for since a near and a remote object may appear under equal angles, though the magnitudes be different, the distance must necessarily be estimated, because the magnitude is great or small according as the distance is. So that the real magnitude is in the compound ratio of the distance and the apparent magnitude; at least when the subtended angle, or apparent magnitude is very small; otherwise, the real magnitude will be in a ratio compounded of the distance and the sine of the apparent magnitude, nearly, or nearer still its tangent. Hence, objects seen under the same angle, have their magnitudes in the same ratio as their distances. The chord of an arc of a circle appears of equal magnitude from every point in the circumference, though one point be vastly nearer than another. Or if the eye be fixed in any point in the circumference, and a right line be moved round so as its extremes be always in the periphery, it will appear of the same magnitude in every position. And the reason is, because the angle it subtends is always of the same magnitude. And hence also, the eye being placed in any angle of a regular polygon, the sides of it will all appear of equal magnitude; being all equal chords of a circle described about it. If the magnitude of an object directly opposite to the eye be equal to its distance from the eye, the whole object will be distinctly seen, or taken in by the eye, but nothing more. And the nearer you approach an object, the less part you see of it. The least angle under which an ordinary object becomes visible, is about one minute of a degree.

The figure of visible objects is estimated chiefly from our opinion of the situation of the several parts of the object. This opinion of the situation, &c. enables the mind to apprehend an external object under this or that figure, more justly than any similitude of the images in the retina with the object can; the images being often elliptical, oblong, &c. when the objects they exhibit to the mind are circles or squares, &c.

The laws of vision, with regard to the figures of visible objects, are, 1. That if the centre of the eye be exactly in the direction of a right line, the line will appear only as a point. 2. If the eye be placed in the direction of a surface, it will appear only as a line. 3. If a body be opposed directly towards the eye, so as only one plane of the surface can radiate on it, the body will appear as a surface. 4. A remote arch, viewed by an eye in the same plane with it, will appear as a right line. 5. A sphere, viewed at a distance, appears a circle. 6. Angular figures, at a distance, appear round. 7. If the eye look obliquely on the centre of a regular figure, or a circle, the true figure will not be seen; but the circle will appear oval, &c.

VISION, is the act of seeing or of perceiving external objects by the organ of sight. As every point of an object, A B C, (Plate XVI. Miscel. fig. 11.), sends out rays in all directions, some rays from every point on the side next the eye, will fall upon the cornea, between E and F, and by passing on through the humours and pupil of the eye, they will be converged to as many points on the retina, or bottom of the eye, and will thereon form a distinct inverted picture, *c b a*, of the object. Thus the pencil of rays, *q r s*, that flows from the point, A, of the object, will be converged to the point, *a*, on the retina; those from the point, B, will be converged to the point *b*; those from the point, C, will be converged to the point *c*; and so of all the intermediate points, by which means the whole image, *a b c*, is formed, and the object made visible, although it must be owned that the method by which the sensation is carried from the eye by the optic nerve to the common sensory in the brain, and there discerned, is above the reach of our conception. That vision is effected in this manner may be demonstrated experimentally. Take a bullock's eye, while it is fresh, and having cut off the three coats from the back part, quite to the vitreous humour, put a piece of white paper over that part, and hold the eye towards any bright object, and you will see an inverted picture of the object upon the paper. The diameters of images at the bottom of the eye are proportional to the angles which the objects subtend at the eye, the same as in a lens, and are reciprocally as the distances of the same object viewed in different places. The eye is in reality no more than a camera obscura; for the rays of light flowing from all the points of an object, through the pupil of the eye, do, by the refraction of its humours, paint the image thereof in the bottom of the eye; just so it is in the camera obscura, where all the rays refracted by a lens in the window-shut-

ter, or passing through a small hole in it, paint the image on the opposite wall. Some properties of the eye are these: the eye can only see a very small part of an object distinctly at once. For the collateral parts of an object are not represented distinctly in the eye; and therefore the eye is forced to turn itself successively to the several parts of the object it wants to view, that they may fall near the axis of the eye, where alone distinct vision is performed. When any point of an object is seen distinctly with both eyes, the axis of both eyes are directed to that point, and meet there; and then the object appears single, though looked at with both eyes; for the optic nerves are so framed, that the correspondent parts in both eyes lead to the same place in the brain, and give but one sensation, and the image will be twice as bright with both eyes as with one. But if the axis of both eyes be not directed to the object, that object will appear double, as the pictures in the two eyes do not fall upon correspondent or similar parts of the retina. The best eye can hardly distinguish any object that subtends at the eye an angle less than half a minute, and very few can distinguish it when it subtends a minute. If the distance of two stars in the heavens be not greater than this, they will appear as one. Though men may see distinctly at different distances, by altering the position and figure of the crystalline, yet they can only see distinctly within certain limits, and nearer than that, objects appear confused. But these limits are not the same in different people. A good eye can see distinctly when the rays fall parallel upon it, and then the principal focus is at the bottom of the eye; a man can judge at a small distance, with a single eye, by frequently observing how much variation is made in the eye to make the object distinct, and from this a habit of judging is acquired. But this cannot be done at great distances, because, though the distance be varied, the change in the eye becomes then insensible. But a man can judge of greater distances with both eyes, than he can with one. For the eyes being at a distance from one another, as long as that distance has a sensible proportion to the distance of the object, one gets a habit of judging, by the position of the axis of the eyes, which are always directed to that point. For different distances require different positions of the axis, which depend on the motions of the eyes, which we feel. But in very great distances no judgment can be made from the motion of the eyes, or their internal parts. Therefore we can only guess at the distances from the magnitude, colour, and the position of interjacent bodies. Dimness of sight generally attends old people, and this may arise from two causes. 1. By the eyes growing flat, and not uniting the rays at the retina, which causes indistinctness of vision; or, 2. By the opacity of the humours of the eye, which in time lose their transparency, in some degree; from whence it follows, that a great deal of the light that enters the eye is stopped and lost, and every object appears faint and dim. Hence the necessity of spectacles.

If objects are seen through a perfectly flat glass, the rays of light pass through it from them to the eye, in a straight direction, and parallel to each other, and consequently the objects appear very little either diminished or enlarged, or nearer, or further off, than to the naked eye; but if the glass they are seen through have any degree of convexity, the rays of light are directed from the circumference towards the centre, in an angle proportional to the convexity of the glass, and meet in a point, at a greater or lesser distance from the glass, as it is more or less convex. This point, where the rays meet, is called the focus, and this focus is nearer or further off, according to the convexity of the glass; for as a little convexity throws it to a considerable distance, so, when the convexity is much, the focus is very near. Its magnifying power is also in the same proportion to the convexity; for as a flat glass scarcely magnifies at all, the less a glass departs from flatness, the less of course it magnifies; and the more it approaches towards the globular figure, the nearer its focus is, and the more its magnifying power. People's different length of sight depends on the same principle, and arises from more or less convexity of the cornea and crystalline humour of the eye; the rounder these are, the nearer will the focus or point of meeting rays be, and the nearer an object must be brought to see it well. The case of short-sighted people is only an over-roundness of the eye, which makes a very near focus; and that of old people is a sinking or flattening of the eye, whereby the focus is thrown to a great distance; so that the former may properly be called eyes of too short, and the latter eyes of too long a focus. Hence, too, the remedy for the last is a convex glass, to supply the want of convexity in the eye

itself, and brings the rays, to a shorter focus: whereas a concave glass is needful for the first to scatter the rays, and prevent their coming to a point too soon. The nearer any object can be brought to the eye, the larger will be the angle under which it appears, and the more it will be magnified. Now, that distance from the naked eye, where the generality of people are supposed to see small objects best, is about six inches; consequently, when such objects are brought nearer than six inches, they will become less distinct; and if to four or three, they will scarcely be seen at all. But by the help of convex glasses we are enabled to view things clearly at much shorter distances than these; for the nature of a convex lens is to render an object distinctly visible to the eye at the distance of its focus; wherefore the smaller a lens is, and the more its convexity, the nearer is its focus, and the more its magnifying power. Now, it is evident from the figure, that if either the cornea, or crystalline humour, or both of them, be too flat, their focus will not be on the retina, where it ought to be, in order to render vision distinct, but beyond the eye. Consequently those rays which flow from the object, and pass through the humours of the eye, are not sufficiently converged to unite, and therefore the observer can have but a very indistinct view of the object. This is remedied by placing a convex glass, of a proper focus, before the eye, which makes the rays converge sooner, and imprints the image duly on the retina. If either the cornea or crystalline humour, or both of them, be too convex, the rays that enter in from the object will be converged to a focus in the vitreous humour, and by diverging from thence to the retina, will form a very confused image thereon; and so, of course, the observer will have as confused a view of the object, as if his eye had been too flat. This inconvenience is remedied by placing a concave glass before the eye, which glass, by causing the rays to diverge between it and the eye, lengthens the focal distance, so that if the glass be properly chosen, the rays will unite at the retina, and form a distinct picture of the object upon it.

VISMEA, in botany, a genus of the Dodecandria Trigynia class and order. Natural order of Onagræ, Jussieu. Essential character: calyx five-leaved, inferior; corolla five-petalled; stigmas five; nut two or three-celled, half inferior. There is but one species, *viz.* V. mocanera, a native of the Canary islands.

VISUAL, in general, something belonging to vision. Thus, rays of light, coming from an object to the eye, are called visual rays; and the visual point in perspective is a point in the horizontal line, wherein all the visual rays unite.

VITAL *air*. See OXYGEN *gas*.

VITEX, in botany, *chaste-tree*, a genus of the Didynamia Angiospermia class and order. Natural order of Personatæ. Vitices, Jussieu. Essential character: calyx five-toothed; corolla-border six-cleft; drupe one-seeded; a four-celled nut. There are fourteen species.

VITIS, in botany, the *vine*, a genus of the Pentandria Monogynia class and order. Natural order of Hederaceæ. Vitices, Jussieu. Essential character: petals cohering at the top, shrivelling; berry five-seeded, superior. There are twelve species, and many varieties.

The most important species of the vitis is V. vinifera, or common vine, which has naked, lobed, sinuated leaves. There are a great many varieties; and all the sorts are propagated either from layers, or cuttings; the latter method is said to be preferable, though the former is much used in this country.

The uses of the fruit of the vine for making wine, &c. are well known. The vine was introduced by the Romans into Britain, and appears formerly to have been very common. From the name of vineyard yet adhering to the ruinous scites of our castles and monasteries, there seem to have been few in the country but what had a vineyard belonging to them. The county of Gloucester is particularly commended by Malmsbury, in the twelfth century, as excelling all the rest in the kingdom in the number and goodness of its vineyards. In the earlier periods of our history, the isle of Ely was expressly denominated the isle of Vines by the Normans. Vineyards are frequently noticed in the descriptive accounts of Doomsday; and those of England are even mentioned by Bede, as early as the commencement of the eighth century.

Doomsday exhibits to us a particular proof that wine was made in England during the period preceding the conquest; and after the conquest, the bishop of Ely appears to have received at least three or four tons of wine annually as tithes, from the produce of the vineyards in his

diocese, and to have made frequent reservations in his leases of a certain quantity of wine for rent. A plot of land in London, which now forms East Smithfield and some adjoining streets, was withheld from the religious house within Aldgate by four successive constables of the tower, in the reigns of Rufus, Henry, and Stephen, and made by them into a vineyard, which yielded great emolument. In the old accounts of rectorial and vicarial revenues, and in the old registers of ecclesiastical suit concerning them, the tithe of wine is an article that frequently occurs in Kent, Surry, and other counties. And the wines of Gloucestershire, within a century after the conquest, were little inferior to the French in sweetness. The beautiful region of Gaul, which had not a single vine in the days of Cæsar, had numbers so early as the time of Strabo. The south of it was particularly stocked with them; and they had even extended themselves into the interior parts of the country; but the grapes of the latter did not ripen kindly. France was famous for its vineyards in the reign of Vespasian, and even exported its wines to Italy. The whole province of Narbonne was then covered with vines; and the wine-merchants of the country were remarkable for knavish dexterity, tinging it with smoke, colouring it (as was suspected) with herbs and noxious dyes, and even adulterating the taste and appearance with aloes. And as our first vines would be transplanted from Gaul, so were in all probability those of the Allobroges in Franche-comté. These were peculiarly fitted for cold countries. They ripened even in the frosts of the advancing winter; and they were of the same colour, and seem to have been of the same species, as the black muscadines of the present day, which have lately been tried in this island, and found to be the fittest for the climate. These were brought into Britain a little after the vines had been carried over all the kingdoms of Gaul, and about the middle of the third century, when the numerous plantations had gradually spread over the face of the latter.

VITMANNIA, in botany, so named in honour of Abbé F. Vitmann, professor at Milan, a genus of the Octandria Monogynia class and order. Essential character: calyx four-cleft; corolla four-petalled; nectary a scale at the base of each filament; nut semi-lunar, compressed, one seeded. There is but one species, *viz.* V. elliptica, a native of the East Indies.

VITRIOL, *natural*, in mineralogy, a species of fossil salts, divided into three sub-species. 1. Iron vitriol. 2. Copper vitriol. 3. Zinc vitriol.

The iron vitriol is of an emerald and verdigris green, sometimes bordering on sky-blue; sometimes on grass green. It occurs massive, tuberose, stalactitic, and crystallized. It occurs usually with iron pyrites, by the decomposition of which it is formed. It is found in many parts of Germany, Italy, Sweden, and in many of the English mines, in Teneriffe, and Greenland. It is employed to dye linen yellow, and wool and silk black; it is also of use in the manufacture of ink, of Berlin blue, for the precipitation of gold from its solution; and sulphuric acid can be obtained from it by distillation, and the residuum, called calcothar of iron, is used as a red paint, and when washed, for polishing steel, glass, &c.

Copper vitriol is of a dark sky-blue colour, which sometimes approaches to verdigris green. It occurs massive, disseminated, stalactitic, dentiform, and crystallized. If a plate of iron be inserted in a solution of copper vitriol, it soon becomes incrusted with metallic copper. With ammonia its solution acquires a blue colour. It is found in many parts of Germany, Sweden, and Siberia, in the copper mines of Ireland, and in Anglesea in Wales. It is used in cotton and linen printing, and the oxide is separated from it, and used as a pigment.

Zinc vitriol is of a greyish colour, and found also in Germany and Sweden.

VITRUVIUS (Marcus Vitruvius Pollio,) in biography, a celebrated Roman architect, of whom however nothing is known, but what is to be collected from his ten books "De Architectura," still extant. In the preface to the sixth book, he writes, that he was carefully instructed in the whole circle of arts and sciences; a circumstance which he speaks of with much gratitude, laying it down as certain, that no man can be a complete architect, without some knowledge and skill in every other branch of knowledge. And in the preface to the first book he informs us, that he was known to Julius Cæsar; that he was afterwards recommended by Octavia to her brother Augustus Cæsar; and that he was so favoured, and provided for, by this emperor, as to be out of all fear of poverty as long as he might live. It is supposed that Vitruvi-

us was born either at Rome or Verona; but it is not known which. His books of architecture are addressed to Augustus Cæsar, and not only show consummate skill in that particular science, but also a very uncommon genius and natural abilities. Cardan ranks Vitruvius as one of the twelve persons, whom he supposes to have excelled all men in the force of genius and invention; and would not have scrupled to have given him the first place, if it could be imagined that he had delivered nothing but his own discoveries. Those twelve persons were, Euclid, Archimedes, Apollonius Pergæus, Aristotle, Archytas of Tarentum, Vitruvius, Achindus, Mahomet Ibn Moses, the inventor or improver of Algebra, Duns Scotus, John Suisset, surnamed the calculator, Galen, and Heber of Spain. The best edition of the architecture of Vitruvius is that of Amsterdam in 1649. Perrault gave an excellent French translation of the same, and added notes and figures: the first edition of which was published at Paris, in 1673, and the second, much improved, in 1684. Mr. William Newton, too, an ingenious architect, published in 1780, &c. curious commentaries on Vitruvius, illustrated with figures; to which is added a description, with figures, of the military machines used by the ancients.

VIVERRA, the *weasel*, in natural history, a genus of Mammalia, of the order Feræ. Generic character: six fore-teeth, rather sharp; tusks longer: tongue in some smooth, in others aculeated backwards; body of a lengthened form. Gmelin separates the Viverra from the Mustela genus, and includes the Lutræ, or otters, under the latter. Mr. Pennant unites the two first, and forms the Lutræ into a distinct genus. This arrangement appears preferable to the other, is adopted by Shaw, and will be followed here. There are forty-five species, of which the following are principally deserving of notice:

V. ichneumon, or the ichneumon, of which there are two varieties, the Indian and the Egyptian. The Egyptian ichneumon is nearly three feet and a half in full length, and of a pale reddish grey colour. It bears a mortal enmity to rats and snakes, and other offensive animals, with which Egypt is infested, and is domesticated frequently in that country for the sake of its services on this account. With the ancient Egyptians it was not only in high estimation, but obtained the reputation of a sort of deity, and was thought entitled to a degree of adoration. Its movements are rapid and agile in the extreme. In approaching its prey it often moves upon its belly like the feline tribe, or rather in the manner of a serpent; at others, it pursues it with rapid boundings. It is able to swim, and to dive also for a considerable time, and frequents chiefly the borders of rivers. The Indian ichneumon is considerably smaller, but is equally useful and esteemed. It attacks without terror, and even with the extreme of fierceness, the most formidable and venomous serpents, particularly the cobra de capello, and destroys them without difficulty. They are both formidable to animals much larger than themselves, fastening upon them with immoveable firmness, and sucking their blood till they are absolutely gorged with it.

V. striata, is a native of Mexico, and discriminated by five longitudinal stripes of white on its back of chocolate colour. When irritated by fear or anger it emits a vapour extremely fetid, in comparison with which every other odour, generally deemed repulsive and disgusting, is pronounced to be the most exquisite perfume. Even the dogs engaged in the pursuit of these creatures are stated to be compelled to abandon the course by this intolerable fetor, and if but a small drop of it should attach to the person or clothes of a human being, it is said to require the ablutions of several days to rid him of the nuisance, and prevent his being any longer avoided with disgust and horror.

V. civetta, or the civet, is a native of the warm territories of Asia and Africa, and above two feet long, exclusively of the tail. It subsists on smaller quadrupeds and birds. This animal is distinguished for its perfume, for which it was well known to the ancients, who considered it as one of the most powerful stimuli, and for which it is kept in a state of confinement in Holland at the present day, as well as in the East. The drug produced by the civets is formed in a glandular receptacle, and is taken from it by its keeper several times in the course of a week; the quantity generally procured from each civet at a time being about a drachm, but varying with the state of the animal's health, and the nourishing quality of its food. It is in its original state of a yellow colour and an unctuous appearance, and is extremely pungent, and indeed disagreeable. Every part of the animal is penetrated by its effluvia, and the effect of being shut up in a room with one of these

creatures in a state of high irritation is nearly intolerable.

V. genetta, or the genet, is to be met with in Syria, Turkey and Spain. These animals are about the size of a small cat, of a more lengthened form in head and body, and of a longer tail. They are distinguished by an agreeable perfume, somewhat similar to musk. They are gentle, easily tamed, exceedingly active and cleanly, and in Constantinople and other places are frequently domesticated, and accomplish all the objects effected by the common cat. Their colour is a tawny-red, spotted with black.

V. foina, or the martin, is of a black tawny colour, and about eighteen inches long. It is the most elegant of the weasel tribe, with a small head, elegant shape, and animated eyes, agile, and graceful in its movements, capable of being reared, when taken young, to great familiarity and sportiveness, yet ever addicted to abandon the full supplies of confinement for the pleasures of freedom, however alloyed these may be by occasional indigence or destitution. It is an inhabitant of the woods, living upon small birds and other animals, and breeding in the holes of trees. It produces no disagreeable effluvia, but is strongly perfumed. Its fur is highly valued.

V. martes, or the pine martin, is distinguished from the former by its yellow breast. It is not frequent in England, but in Germany, Sweden, and North America, it is easily met with, particularly in woods of pine trees. Its fur is preferred considerably to that of the last. It confines itself to woods and fields, never entering the habitations of man, and breeds often in the nest of the squirrel, the buzzard, and the wood-pecker.

V. zibellina, or the sable, is about the same size as the martin. Its general colour is a deep shining brown, and the hair is ashcoloured at the roots, and black at the tips. It is found in the Arctic regions, and its fur is a most valuable article of commerce, when of a particular extent and beauty, being sold for from twelve to fifteen pounds. This extraordinary price for the skin of so small an animal induces the robust and hardy natives of the north to hunt sables amidst the rigours of winter with unwearied assiduity and preseverance. These make their progress over regions covered with snow, and in the most intense severity of winter, marking the trees as they advance, that they may recognize their direction for return, and sometimes, after spreading a net before the entrance of one of the burrows of a sable, waiting often even two whole days for the animal's appearance, and sometimes of course waiting in vain. These men, during the extreme hunger which they sometimes experience, find some allay to it by pressing on their stomachs, with tightened cords, thin pieces of board. The furs are most valued which are taken between November and February. The hunting in Siberia was formerly conducted by criminals banished to that country, and by soldiers sent to it for this particular business, and who were stationed there for several years, and both were obliged to furnish a certain number of skins. Sables are extremely active and lively by night, but spend the greater part of the day in sleep. They subsist on squirrels and small birds, which they pursue from one tree to another with the most elastic agility. Rats, pine tops, and fruits, are also eaten by them. They are stated also to be fond of fish, and to be capable both of diving and swimming. They live in holes in the banks of rivers, and under the roots of trees. See Mammalia, Plate XVI. fig. 5.

V. putorius, or the pole-cat, bears a very striking resemblance to the martin, is possessed of extreme nimbleness and activity, and climbs trees, and even creeps up walls, with great rapidity. It devours the smaller animals without discrimination, and pigeons, poultry, and rabbits, experience from it most fatal havoc. During winter its necessities urge it to frequent, if possible, not only the barn, but also the dairy. It is stated, on respectable authority, that in some instances pole-cats have been observed to feed on fishes, particularly eels, which they have dragged from rivulets at a distance to their habitation, repeating their labours many times in the course of a single night, and consequently accumulating a great number of these fishes for their subsistence. This animal has been known in winter to attack bee-hives, and devour the honey. It is extremely fierce, and will defend itself with astonishing spirit, even against dogs. It is distinguished for the most disagreeable odour, which, however, is not retained in the skin long after the animal is killed, this being dressed with the fur on it, and being held in considerable estimation. The female produces, in summer, five or six young ones, which require the attentions of the parent only for a short time, and are trained to suck the blood of the animals procured by her for their support. Inhabits North America.

V. furor, or the ferret, resembles the

pole-cat both in form and manners. It is a native of Africa, whence it is stated to have been imported into Spain for the destruction of the rabbits, which had multiplied in that country to the most injurious excess. It was thence introduced into other European countries, but is ill adapted to endure the rigours of a northern winter, being particularly susceptible of cold. It may be tamed, but appears little capable of gratitude or attachment, and has such a thirst for blood, that it has been known to grasp at the throats of infants in the cradle, and suck them till it has been completely gorged. It breeds twice a year, and will occasionally devour its young as soon as they are produced. In confinement it must be kept in a box provided with wool, or other warm materials, and may be fed with bread and milk. Its sleep is long and profound, and it awakes with a voracious appetite, which is most highly gratified by the blood of small and young animals. Its enmity to rats and rabbits is unspeakable, and when either are, though for the first time, presented to it, it seizes and bites them with the most phrensied madness. When employed to expel the rabbit from its burrows, it must be muzzled, as otherwise it will suck the blood of its victim, and instantly fall into a profound sleep, from which it will awake only to the work of destruction, committing in the warren, where it was introduced only for its services, the most dreadful waste and havoc. It is possessed of high irritability, and when particularly excited, is attended with an odour extremely offensive. See Mammalia, Plate XVI. fig. 4.

V. vulgaris, or the common weasel of England, is about nine inches long, including the tail, is elegant in its appearance, and light in its movements, but unpleasant by the odour which accompanies it. It dwells under the roots of trees, and subsists on field mice, small birds, and even young rabbits. It is also particularly fond of eggs. It is often fatal to the hare itself, which appears to entertain for the weasel extreme terror, and to be overwhelmed at the sight of it into a complete incapacity for resistance. It is a more formidable enemy to rats and mice than even the cat itself, as it has greater facility for pursuing them to their retreats, and on this account it is much valued and encouraged by the farmer. Its bite is said to be almost certainly, though not always immediately, fatal. Its teeth are extremely sharp, and generally first fixed on the head of its enemy, which often lingers in stupor, but scarcely ever regains soundness. It commences its depredations in the evening, and when it has produced its young, ranges with extreme intrepidity and rapacity. It is frequent near corn-mills, and wherever rats and mice are abundant, and always retires with its prey to its burrow, instead of devouring it on the spot where it was killed, preferring it in a state of putrefaction. During confinement, it appears highly agitated and restless, and has by many been supposed untameable, but Madamoiselle de Laistre has given an interesting and full detail of the manners of one which she undertook to protect and instruct, and which repaid her assiduity by the most sportive vivacity, the most harmless conduct, and even the most grateful attachment. For the stoat, see Mammalia, Plate XVI. fig. 3. Vol. iv.

VIVIANI (Vincentio,) a celebrated Italian mathematician, was born at Florence, in 1621, some say 1622. He was a disciple of the illustrious Galileo, and lived with him from the 17th to the 20th year of his age. After the death of his great master, he passed two or three years more in prosecuting geometrical studies without interruption, and in this time it was that he formed the design of his Restoration of Aristeus. This ancient geometrician, who was contemporary with Euclid, had composed five books of problems, "De Locis Solidis," the bare propositions of which were collected by Pappus, but the books are entirely lost; which Viviani undertook to restore by the force of his genius.

He broke this work off before it was finished, in order to apply himself to another of the same kind, which was, to restore the fifth book of Apollonius's "Conic Sections." While he was engaged in this, Borelli found, in the library of the Grand Duke of Tuscany, an Arabic M. S. with a Latin incription, importing that it, contained the eight books of Apollonius's Conic Sections; of which the eighth was not found to be there. He carried this MS. to Rome, in order to translate it with the assistance of a professor of the oriental languages. So unwilling, however, was Viviani to lose the fruits of his labours, that he refused to receive the smallest account from Borelli on the subject. At length he finished the work, and published it in 1659, with the title "De Maximis et Minimis geometrica divinatio in quintum conicorum Apollonii Pergæi." He was called by the state to undertake an operation of great import-

ance, *viz.* to prevent the innundations of the Tiber, in which Cassini and he were employed for some length of time. On account of his great talents he received a pension from Louis XIV. In 1666 he was honoured by the Grand Duke with the title of the first mathematician. He resolved three problems which had been proposed to all the mathematicians of Europe. In 1669 he was chosen to fill, in the Royal Academy of Sciences, a place among the eight foreign associates. This circumstance, so honourable to his reputation, gave new vigour to his exertions, and he published three books of the "Divination upon Aristeus," in 1701, which he dedicated to the King of France. Viviani acquired a good fortune, which he laid out in building a magnificent house at Florence; here he placed a bust of Galileo, with several inscriptions in honour of that great man. He died in 1703, aged 81.

VIVIPAROUS, in natural history, an epithet applied to such animals as bring forth their young alive and perfect, in contradistinction to them that lay eggs, which are called oviparous animals.

ULEX, in botany, *furze* or *gorse*, a genus of the Diadelphia Decandria class and order. Natural order of Papilionaceæ, or Leguminosæ. Essential character: calyx two-leaved; legume scarcely longer than the calyx; filaments all connected. There are three species.

ULLAGE, in gauging, so much of a cask, or other vessel, as it wants of being full. See GAUGING.

ULMUS, in botany, the *elm*, a genus of the Pentandria Digynia class and order. Natural order of Scabridæ. Amentaceæ, Jussieu. Essential character: calyx five-cleft, inferior permanent; corolla none; capsule membranaceous, compressed, flat, one-seeded. There are seven species, two of which are natives of Britain, *viz.* the campestris, common elm; and the montana, or wych elm. All the sorts of elm may be either propagated by layers, or suckers, taken from the roots of the old trees, the latter of which is generally practised by the nursery gardeners. The elm delights in a stiff strong soil. It is observable, however, that here it grows comparatively slow. In light land, especially if it is rich, its growth is very rapid; but its wood is light, porous, and of little value, compared with that which grows upon strong land, which is of a closer, stronger texture, and at the heart will have the colour, and almost the heaviness and the hardness of iron. On such soils the elm becomes profitable, and is one of the trees which ought, in preference to all others, to engage the planter's attention.

ULTRAMARINE. This precious colour, so remarkable for its beauty and durability, is a pure deep sky blue. It is capable of bearing a low red heat without injury, and it is not sensibly impaired by the action of the air and weather. It is the colouring matter of the mineral already described under the name LAZURSTEIN, and appears, according to an analysis by Klaproth, to consist of little else than oxide of iron.

ULVA, in botany, a genus of the Cryptogamia Algæ class and order. Generic character: fructifications are small globules, dispersed through a pellucid membranaceous or gelatinous substance, or frond.

UMBELLIFEROUS *plants* are such as have their tops branched and spread out like an umbrella; on each little subdivision of which there is growing a small flower; such are fennel, dill, &c.

UMBER. There are two kinds of umber, the one called Cologne umber, is a variety of peat or of earthy brown coal. There are large beds of it wrought in the neighbourhood of Cologne, principally as an article of fuel; a pretty considerable quantity is also imported into Holland, where it is used in the manufacture, or more properly in the adulteration, of snuff; for which purpose it appears to be better than the common peat of the country; a still smaller quantity is consumed by the paint-makers. The colour of this vegetable umber is a warm somewhat pinkish brown, and is an useful ingredient to the painter in water-colours. The second kind of umber goes by the name of Turkish umber, and appears to be a variety of the iron ore called brown ironstone ochre. A specimen from Cyprus was analysed by Klaproth, and afforded him.

Oxide of iron	48
Oxide of manganese	20
Silex	13
Alumine	5
Water	14
	100

UNCARIA, in botany, a genus of the Pentandria Monogynia class and order. Essential character: corolla salver-shap-

ed; germ crowned with a gland; stigma two-grooved; pericarpium two-celled, many-seeded. There are two species, *viz.* U. inermis, and U. aculeata.

UNCIA, in general, a Latin term denoting the twelfth part of any thing; particularly the twelfth part of a pound, called in English an ounce; or the twelfth part of a foot, called an inch.

UNCIÆ, in algebra, the numbers prefixed before the letters of the members of any power produced from a binomial, residual, or multinomial root. Thus, in the fourth power of $a+b$, *viz.* $a^4+4a^3b+6a^2b^2+4ab^3+b^4$, the unciæ are 4, 6, 4; being the same with what others call co-efficients. See Binomial, Algebra, &c.

UNDECAGON, in geometry, is a polygon of eleven sides. If the side of a regular undecagon be 1, its area will be 9.36564 nearly $= \frac{11}{4} \times$ tang. of $73\frac{7}{11}$ degrees; and therefore, if this number be multiplied by the square of the side of any other regular undecagon, the product will be the area of that undecagon.

UNDER *currents*, currents distinct from the upper or apparent currents of the seas. Some naturalists conclude that there are in divers places under-currents, which set or drive a contrary way from the upper current, whence they solve the remarkable phenomena of the sea's setting strongly through the Streights into the Mediterranean, with a constant current twenty leagues broad; as also, that running from the Euxine through the Bosphorus into the Hellespont, and thence into the Archipelago; they conjecture that there is an under current whereby as great a quantity of water is carried out as comes in. To confirm this it is observed, that between the North and South Foreland, it is either high or low water upon the shore three hours before it is so off at sea; a certain sign, that though the tide of flood runs aloft, yet the tide of ebb runs under foot, or close by the ground. Yet Dr. Halley solves the currents setting in at the Streights without overflowing the banks, from the great evaporation, without supposing any under current.

UNDERSTANDING, or Judgment, in the Hartleyan acceptation of the term, is that faculty by which we contemplate mere sensations and ideas, pursue truth, and assent to, or dissent from, propositions. In this article, and in Words, we shall, as we proposed in Philosophy, *mental*, § 104, lay before our readers a view of the highly important principles of Hartley respecting the understanding, occasionally making in his statements such alterations as will best adapt them to our object.

Whatever be the precise nature of assent and dissent, they must class with ideas, being only those very complex internal feelings which are connected by association with those groups of words, which are called propositions in general, or affirmations and negations in particular.—Assent (and consequently its opposite, dissent) may be distinguished into two kinds, rational and practical. Rational assent to any proposition may be defined a readiness to affirm it to be true, proceeding from a close association of the ideas suggested by the proposition, with the idea or internal feeling belonging to the word truth; or of the terms of the proposition with the word truth. Rational dissent is the opposite to this.—Practical assent is a readiness to act in such a manner as the frequent vivid recurrency of the rational assent disposes us to act; and practical dissent the contrary.

Practical assent is then the natural consequence of rational assent, when sufficiently impressed. It must, however, be observed, first, that some propositions, mathematical ones for instance, admit only of a rational assent, the practical not being applied to them in common cases: secondly, that the practical assent is sometimes generated, and arrives at a high degree of strength, without any previous rational assent, and by methods which have little or no connection with it; yet still is in general much influenced by it, and, conversely, exerts a great influence upon it: thirdly, practical assent may be in opposition to rational assent, and in consequence of its having been long and firmly cultivated, may altogether prevent the latter from influencing the conduct.

Let us next inquire into the causes of rational and practical assent, beginning, 1. with that given to mathematical conclusions.—Now the original cause that a person affirms the truth of the proposition, twice two are four, is the entire coincidence of the visible or tangible idea of twice two, with that of four, as impressed upon the mind by various objects. We see every where that both are only different names for the same impression; and it can only be in consequence of association, that the word truth, its definition, or internal feeling, becomes appro-

priated to this coincidence.—Where the numbers are so large that we cannot form any distinct visible ideas of them, as when we say 12 times 12 are equal to 144, rational assent is founded (if not on the authority of a table or a teacher) on a coincidence of words arising from some method of reckoning up 12 times 12, so as to conclude with 144, and resembling the coincidence of words which attends the before-mentioned coincidence of ideas in the simpler numerical propositions.—The operations of addition, subtraction, multiplication, division, and extraction of roots, with all the most complex operations relating to algebraic quantities, considered as the denotements of numbers, are no more than methods of producing this coincidence of words, founded upon and rising above one another. And it is merely association again which appropriates the word truth, &c. to the coincidence of the words or symbols which denote the numbers.

This coincidence of terms is considered as a proof that the visible ideas of the numbers under consideration would coincide as much as the visible ideas of twice two and four, were the former equally distinct with the latter; and indeed the same thing may be fully proved, and often is so, by experiments with counters, lines, &c. And hence, thinking persons, who make a distinction often unthought of, between the coincidence of terms and that of ideas, consider the real and absolute truth to be as great in complex numerical propositions, as in the simplest. Now as it is impossible to gain distinct visible ideas of different numbers, where at least they are considerable, terms denoting them are a necessary means of distingishing them one from another, so as to reason justly respecting them.

In geometry there is a like coincidence of lines, angles, spaces, and solid contents, to prove them equal in simple cases. Afterwards, in complex cases, we substitute the terms whereby equal things are denoted for each other, and then the coincidence of the terms to denote the coincidence of the visible ideas, except in the new step advanced in the proposition : and thus we get a new quality, denoted by a new coincidence of terms; and this in like manner we employ in order to obtain a new equality. This resembles the addition of unity to any number in order to make the next, as of 1 to 20 in order to make 21. We have no distinct visible idea of 20 or of 21; but we have of the difference between them, by fancying to ourselves a confused heap of things, supposed or called twenty in number, and then further fancying one thing to be added to it. By a like process in geometry we arrive at the demonstration of the most complex propositions.—The properties of numbers are applied to geometry in many cases, as when we demonstrate a line or space to be half or double of any other, or in any other ratio to it.—And as in arithmetic words stand for indistinct ideas, in order to help us to reason about them as accurately as if they were distinct; as also cyphers stand for words, for the same purpose; and letters for cyphers, to render the conclusions less particular; so letters are put for geometrical quantities also, and the agreements of the letters for those of the quantities.

Thus we see the foundation upon which the whole doctrince of quantity is built; for all quantity is denoted either by numbers, or by extension, or by letters denoting either one or the other. The coincidence of ideas is the foundation of rational assent in simple cases; and that of ideas and of terms, or of terms alone, in complex cases. This is upon the supposition that the quantities are to be proved equal; but if they are to be proved unequal, the want of coincidence answers the same purpose. If they are in any numerical ratio, this is only introducing a new coincidence.—Thus it appears that the use of words, (either as visible or as audible symbols,) is necessary for geometrical and algebraic reasonings, as well as for arithmetical. Also that association prevails in every part of the processes hitherto described.

But these are not the only causes of giving rational assent to mathematical propositions. The recollection of having once examined and assented to each step of a demonstration, the authority of an approved writer, &c. are often sufficient to gain our assent, though we understand no more than the import of the proposition; nay, even though we do not proceed so far as this. Now this again is a mere transfer of association; the recollection, authority, &c. being in a great number of cases associated with the before-mentioned coincidence of ideas and terms.—But here a new circumstance arises; for memory and authority are sometimes found to mislead; and the recollection of such experience puts the mind into a state of doubt, so that sometimes truth, sometimes falsehood, will recur, and unite itself with the proposition

under consideration, according as the recollection, authority, &c. in all their peculiar circumstances, have been associated with truth or with falsehood.

Thus the idea belonging to a mathematical proposition, with the rational assent or dissent arising in the mind, as soon as it is presented to it, is nothing more than a group of ideas united by association, and forming a very complex idea (§ 53). And this idea is not merely the sum of the ideas belonging to the terms of the proposition, but also includes the notions or feelings, whatever they be, which belong to the words equality, coincidence, and truth, and, in some cases those of utility, importance, &c.—For mathematical propositions are, in some cases, attended with a practical assent, in the proper sense of these words; as when a person takes this or that method of executing a projected design, in consequence of some mathematical proposition assented to from his own examination, or from the authority of others. Now the train of voluntary actions denoting the practical assent, is produced by the frequent recurrency of ideas of utility and importance. These operate by association, and though the rational assent be a previous requisite, yet the degree of the practical assent is proportional to the vividness of those ideas; and in most cases they strengthen the rational assent by reaction.

II. Propositions concerning natural bodies are of two kinds, vulgar and scientifical. Of the first kind are, "milk is white," "gold is yellow," "a dog barks," &c. These are evidently nothing more than forming the terms denoting the whole or some component parts of the complex idea, into a proposition, or employing those denoting some of its common adjuncts in the same way. The assent given to such propositions arises from the associations of the terms as well as of the ideas denoted by them.

In scientifical propositions concerning natural bodies, a definition having been made of the body from its properties, another property or power is joined to them as a constant or common associate. Thus gold is said to be soluble in the nitro-muriatic acid. Now to persons who have made the proper experiments a sufficient number of times, these words suggest the ideas which occur in those experiments, and conversely are suggested by them, in the same manner as the vulgar propositions above mentioned suggest, and are suggested by, common appearances. But then, if they be scientific persons, their readiness to affirm that gold is soluble in this acid universally, arises also from the experiments of others, and from their own and other persons' observations on the constancy and tenor of nature. They find it to be a general truth, that almost any two or three remarkable qualities of a natural body, infer the rest, being never found without them; and hence arises a readiness to affirm respecting all bodies possessing those two or three leading qualities, whatever may be affirmed of one.

The propositions formed respecting natural bodies are often attended with a high degree of practical assent, arising chiefly from some supposed utility and importance, and which is no way proportioned to the foregoing or similar acknowledged causes of rational assent. And in some cases the practical assent takes place before the rational; but then, after some time, the rational assent is generated and cemented most firmly by the prevalence of the practical. This process is particularly observable in the regards paid to medicines; that is, in the rational and practical assent to the propositions concerning their virtues.

The influence of the practical assent over the rational, arises from their being united in so many cases. And the vividness of the ideas arising from the supposed utility, importance, &c. produce a more ready and closer union of the terms of the proposition.

III. The evidences for past facts are a man's own memory, and the authority of others. These are, under proper restrictions, the usual associates of true past facts, and therefore produce the readiness to affirm a past fact to be true, that is, the rational assent. The integrity and competency of the witnesses being the principal restriction or requisite in the accounts of past facts, become principal associates to the assent to them; and the contrary qualities to dissent.

If it be asked, how a narration of an event supposed to be certainly true, or to be doubtful, or to be entirely fictitious, differs in its effect upon the mind in these circumstances respectively, the words in which it is narrated being the same in case? it may be replied, first, in having the terms true, doubtful, or fictitious, with a variety of ideas usually associated with them, and the corresponding internal feelings of respect, anxiety, dislike, &c. con-

nected with them respectively; whence the whole effects, exerted by each upon the mind, will differ considerably from one another. Secondly, if the events be of a very interesting nature, the related ideas will recur oftener, and thus agitate the mind the more, in proportion to the supposed truth of the event. And it confirms this, that the frequent recurrence to the mind of an interesting event, supposed to be doubtful, or even fictitious, by degrees makes it appear like a real one. The practical assent to past facts often produces the rational assent, as in the other cases before spoken of.

IV. The evidence for future facts is of the same kind with that for the propositions concerning natural bodies, being, like it, taken from induction and analogy. This is the foundation of the rational assent. The practical depends upon the recurrency of the ideas, and the degree of agitation produced by them in the mind. Hence reflection makes the practical assent grow for a long time after the rational is arisen to its height; or, which is often the case, if the practical assent arises, in any considerable degree, without the rational, it will generate the rational. Thus the sanguine are apt to believe and assert what they hope to be true; and the timorous what they fear.

V. There are many speculative abstract propositions in logic, metaphyscis, ethics, controversial divinity, &c. the evidence for which is the coincidence or analogy of the abstract terms, in certain particular applications of them, or as considered in their grammatical relations. This causes the rational assent. As to the practical assent or dissent, it arises from the ideas of importance, reverence, piety, duty, ambition, jealousy, envy, self-interest, &c. which intermix in these subjects, and thus in some cases, add great strength to the rational assent, in others destroy it, and convert it into its opposite.

On the whole it appears, that rational assent has different causes in propositions of different kinds, and practical assent in like manner: that the causes of rational are also different from those of practical; that there is, however, a great affinity and general resemblance in all the causes; that rational and practical assent exert a perpetual reciprocal influence on each other; and, consequently, that the ideas belonging to assent and dissent, and their equivalents and relatives, are highly complex, unless in the cases of very simple propositions, such as mathematical ones. For, besides the coincidence of ideas and terms, they include in other cases, ideas of utility, importance, respect, disrespect, ridicule, religious affections, hope, fear, &c. and bear some gross general proportion to the vividness of these ideas.

It follows from the preceding statements, that vicious men, that is, all persons who want practical faith, must be prejudiced against the historical and other foundations for rational faith in revealed religion. Further, it is impossible any person should be so sceptical as not to have the complex ideas denoted by the words assent and dissent associated with a great variety of propositions, in the same manner as in other persons; just as he must have the same ideas in general affixed to the words of his native language as other men have. An universal sceptic is therefore no more than a person who varies from the common usage in his application of a certain set of words, *viz.* truth, certainty, assent, dissent, &c.

We shall close this article with the very important remarks on evidence, given by Hartley, in proposition 87; referring to the original those readers, who wish to see how he illustrates or proves them by the employment of simple mathematical expressions, and who are disposed to enter into his important observations respecting the ascertainment of truth and the advancement of knowledge.

1. If the evidences for any proposition, fact, &c. be dependent on each other, so that the first is required to support the second, the second the third, and so on; that is, if a failure of any one of the evidences renders all the rest of no value, the separate probability of each evidence must be very great in order to make the proposition credible; and this holds so much the more, as the dependent evidences are more numerous.

2. If the evidences for any proposition, fact, &c. be independent on each other; that is, if they be not necessary to support each other, but concur, and can each of them, when established upon its own proper evidences, be applied directly to establish the proposition, fact, &c. in question, the deficiency in the probability of each must be very great, in order to render the proposition perceptibly doubtful, and this holds so much the more, as the evidences are more numerous.

3. The resulting probability may be sufficiently strong in dependent evidences, and of little value in independent ones, according as the separate probability of each evidence is greater or less. Thus

the principal facts of ancient history are not less probable practically now, than ten or fifteen centuries ago; nor less so then, than in the times immediately succeeding, because the diminution of evidence in each century is imperceptible. And for the same reason a large number of weak arguments prove little.

4. It appears likewise, that the inequality of the separate evidences does not produce much alteration in these remarks. In like manner, if the number of evidences, dependent or independent, be great, we may make great concessions as to the value of each. Again, a strong evidence in dependent ones can add nothing, but must weaken a little; and after a point is well settled by a number of independent ones, all that come afterwards are in one sense useless, because they do no more than remove the imperceptible remaining deficiency; on the other hand, however, as evidence produces different effects on different minds, it is of great moment in all points of general importance, to have as many satisfactory independent evidences as possible brought into view; that if one fail in its effects, from peculiar circumstances, another may supply its place. And it will be of great use to pursue these and such like deductions, both mathematically, and by applying them to proper instances selected from the sciences, and from common life, in order to remove certain prejudices, which the use of general terms and ways of speaking, with the various associations with them, is apt to introduce and fix upon the mind. It cannot but assist us, in the art of reasoning, thus to analyze, recompose, and ascertain our evidences.

UNDULATION, in physics, a kind of tremulous motion or vibration observable in a liquid, whereby it alternately rises and falls like the waves of the sea. Thus undulatory motion, if the liquid be smooth and at rest, is propagated in concentric circles, as most people have observed upon throwing a stone, or other matter, upon the surface of a stagnant water, or even upon touching the surface of the water lightly with the finger, or the like. The reason of these circular undulations is, that by touching the surface with your finger, there is produced a depression of the water in the place of contact. By this depression, the subjacent parts are moved successively out of their place, and the other adjacent parts thrust upwards, which lying successively on the descending liquid, follow it; and thus the parts of the liquid are alternately raised and depressed, and that circularly. When a stone is thrown into the liquid, the reciprocal vibrations are more conspicuous: here the water, in the place of immersion, rising higher by means of the impulse, or rebound, till it comes to fall again, gives an impulse to the adjoining liquid, by which means that is likewise raised about the place of the stone as about a centre, and forms the first undulous circle; this falling again, gives another impulse to the fluid next to it, further from the centre, which rises likewise in a circle; and thus successively greater and greater circles are produced.

UNGULA, in geometry, the section of a cylinder cut off by a plane passing obliquely through the plane of the base and part of the cylindric surface.

UNICORN, an animal famous among the ancients, but looked upon by the moderns as fabulous, denominated from its distinguishing characteristic of having one horn only, which is represented as five palms long, and growing in the middle of the forehead.

The unicorn is one of the supporters of the British arms. It is represented, by heralds, passant, and sometimes rampant. When in this last action, as in the British arms, it is properly said to be saillant. Argent, an unicorn sejant sable, armed and unguled, or, borne by the name of harding.

UNICORN *fish*. See MONODON.

UNIOLA, in botany, a genus of the Triandria Digynia class and order. Natural order of Gramina. Gramineæ, Jussieu. Essential character: calyx many-valved; spikelet ovate, keeled. There are three species.

UNONA, in botany, a genus of the Poliandria Polyginia class and order. Natural order of Coadunatæ. Anonæ, Jussieu. Essential character: calyx three-leaved; petals six; berries two or three-seeded, jointed like a necklace. There are four species.

UNISON, in music, the effect of two sounds which are equal in degree of tune, or in point of gravity and acuteness.

UNITARIANS, in church history, are those who believe that there is but one God, the supreme object of religious worship; and that this God is the Father only, and not a Trinity consisting of Father, Son, and Holy Ghost.

The Unitarians having been frequently confounded with the old Socinians, it is but justice to observe, that a very material difference exists in some parts of the

religious faith of these two sects. The Socinians believed that Jesus Christ, though a human being, was advanced by God to the government of the whole created universe, and was, therefore, the proper object of religious worship. On account of their essential deviation from the doctrine of Socinus, in this and some other respects, the modern Unitarians disclaim the appellation Socinian, as inapplicable to their views of religious faith and worship. This term is, however, very comprehensive, and is applicable to a great variety of persons, who, notwithstanding, agree in this one common principle, that there is no distinction in the divine nature.

The appellation of Unitarian may be considered as a generic term, including in it a number of specific differences. Indeed, all those who reject the doctrine of the Trinity, and pay divine worship to the Father only, may with propriety be called Unitarians. As it is a principle among this body of Christians, that the most unbounded liberty ought to be granted to every individual to understand and explain the doctrines of the Scriptures according to his own particular views, it has long been divided into a number of parties, differing on various subjects not immediately affecting the leading doctrine of the Divine Unity. Though the ancient Arians appear never to have adopted this appellation, yet most of their successors of the present day assert, that they have a just claim to the title; because, they say, that they pay divine adoration to the one God and Father only, and not to Jesus Christ, or to the Holy Ghost. If this be admitted, it will appear that the Unitarian doctrine is of very ancient date. Indeed, they profess to derive their faith solely from the sacred Scriptures of the Old and New Testaments.

Soon after the Nicene Council, when the Christian world had wearied itself with religious wars and disputes concerning doctrines and government, and the Papal power had, apparently, converted the kingdom of Christ into a kingdom of this world, the subjects of religious controversy ceased, in a great degree, to agitate the minds of men, until the memorable period of the Reformation. Then again did the flame, which had been long smothering, burst out; and the great and leading maxim, of the right of private judgment in matters of religion, on which the Reformation was founded, once more gave liberty to the powers of the human understanding. How far those powers were exerted against many of the doctrines of the Church of Rome, we have already described in the articles PROTESTANTS and REFORMATION. Though Luther and his adherents had done much towards effecting a complete reformation in religion, it was thought by many persons of great learning and piety, that much still remained to be cleared away, before the religion of Jesus Christ could again assume its native lustre and purity. Among the number of those who were of this opinion, was a learned and eminent physician of Spain, commonly called Michael Servetus. This gentleman, conceiving that the ideas generally maintained concerning the Trinity, and some other popular doctrines, were false and dangerous, discovered and propagated what he conceived to be a more rational theory; the leading features of which related to the doctrine of the Trinity, which he flatly denied; at least in the manner in which it was then commonly understood.

On this subject he published his famous book, entitled "De Trinitatis Erroribus;" with which, as Oecolampadius, writing to Bucer, observes, the reformers at Berne were very much offended. At the same time he remarks, that the churches would be very ill spoken of, unless their divines would make it their business to "cry it down." "We know not," he continues, "how that beast, (Servetus) came to creep in among us; he wrests all passages of Scripture to prove, that the Son is not co-eternal and consubstantial with the Father, and that the man Christ is the Son of God."

Now it was, that the fears of Melancthon began to be realized. In a letter to Joachim Cameraper, this reformer thus expresses himself: "You know that I was always afraid, that these disputes about the Trinity would break out some time or other. Good God! what tragedies will this question produce among posterity;—whether the Logos be a substance or a person." To alleviate, in some measure, these fears, this meek reformer wrote a letter to the Popish Senate at Venice, beseeching them to use their utmost endeavours to prevent the spread of the errors contained in Servetus's book. It was, however, reserved for the zeal of Calvin to convince the religious world, that the reformers, with all their zeal against popery, had not learned to shake off a spirit of fiery persecution against those whom they chose to account

heretics. Not content with calling Servetus "the proudest knave of the Spanish nation," "a villanous, obscene, barking dog, a blockhead and a beast," this furious bigot, with all the abominable cant with which the genius of his religious creed could amply supply him, caused the unhappy Servetus to be burnt at the stake as a heretic, after having harassed and tormented him in every possible way that the most determined villainy and artful hypocrisy could suggest. Thus died the first Unitarian martyr after the Reformation; and thus was he treated by one of the principal reformers!

It was probably from the books of Michael Servetus, that Lælius Socinus, and many other Italians, first imbibed their anti-trinitarian opinions. From the papers of Lælius Socinus, his nephew, Faustus Socinus, was afterwards led to the study of theology. He improved on the system of his uncle; and was the cause of the Unitarian doctrine spreading itself over a great part of Europe. In Poland, in particular, this sect made astonishing progress. By them was published the famous Racovian Catechism; and the writings of the Polones Fratres, in six large folio volumes, entitled "Bibliotheca Fratrum," are replete with learning and great biblical knowledge. The leading doctrines maintained by the Polonian brethren are as follow:

That the Holy Scriptures are to be understood and explained in such a manner, as that their doctrines shall be strictly agreeable to the true principles of reason.

In consequence of this leading point in their theology, they maintained that God, who is infinitely more perfect than man, though of a similar nature in some respects, exerted an act of that power by which he governs all things; in consequence of which, an extraordinary person was born of the Virgin Mary. That person was Jesus Christ, whom God first translated to heaven by that portion of his divine power called the Holy Ghost. Socinus and some of his followers entertained this notion of Christ's having been, in some unknown time of his life, taken up personally into heaven, and sent down again to the earth, by which they solved these expressions concerning him: "No man has ascended to heaven but he that came down from heaven, even the Son of Man which is in heaven," (John iii. 13) Thus Moses, who was the type of Christ, before the promulgation of the law, ascended to God upon Mount Sinai. So Christ, before he entered on the office assigned him by the Father, was, in consequence of the divine council and agency, translated into heaven, that he might see the things he had to announce to the world in the name of God himself. Being thus fully instructed in the knowledge of his counsels and designs, he sent him again into this sublunary world, to promulgate to mankind a new rule of life, more excellent than that under which they had formerly lived, to propagate divine truth by his ministry, and to confirm it by his death.

That those who obey the voice of this divine teacher (and this obedience is in the power of every one whose will and inclination lead that way) shall one day be clothed with new bodies, and inhabit eternally those blessed regions where God himself immediately resides. Such, on the contrary, as are disobedient and rebellious, shall undergo most terrible and exquisite torments, which shall be succeeded by annihilation, or the total extinction of their being.

Faustus Socinus supposed that, in condescension to human weakness, in order that mankind might have one of their own brethren more upon a level with them, to whom they might have recourse in their straits and necessities, Almighty God, for his eminent virtues, had conferred upon Jesus Christ, the Son of Mary, some years after he was born, a high divine power, lordship, and dominion, for the government of the christian world only; and had qualified him to hear and answer the prayers of his followers in such matters as related to the cause of the gospel. The chief foundation on which Socinus founded the opinion of Christ's being an object of religious worship, was the declarations in the scriptures concerning the kingdom and power bestowed upon him. The interpretation which he put on those passages which speak of angels and heavenly powers being put under him, and worshipping him; his having a knowledge of the secret thoughts of men imparted to him, and the like, which, with some presumed instances of the fact, of prayer being actually made to him, he maintained to be a sufficient though indirect signification of the divine will, that men should invoke Christ by prayer. But he constantly acknowledged that there was no express precept for making him an object of religious worship.

Socinus allowed that the title of true God might be given to Christ; though all he meant by it was, that he had a real divine power and dominion bestowed upon him, to qualify him to take care of the concerns of christians, and to hear and answer their prayers, though he was originally nothing more than a human creature.

There were some among the early Socinians who disapproved and rejected the worship paid to Christ, as being without any foundation in the Holy Scriptures, the only rule of Christian faith and worship.

This is a general outline of the doctrines of the Socinians.

The Unitarians, of the present day, are principally divided into Arians and Humanitarians, or believers in the simple humanity of Christ. For an account of the first of these two classes, see the article ARIANS. The summary of doctrines held by modern Unitarians is as follows: The capital article in the religious system of this denomination is, that Christ was a mere man. But they consider him as the great instrument in the hands of God of reversing all the effects of the fall; as the object of all the prophecies from Moses to his own time; as the great bond of union to virtuous and good men, who, as christians, make one body in a peculiar sense; as having communications with God, and speaking and acting from God, in such a manner as no other man ever did, and therefore, having the form of God, and being the Son of God in a manner peculiar to himself; as the mean of spreading divine and saving knowledge to all the world of mankind; as, under God, the head of all things to his church; and as the Lord of life, having power and authority from God to raise the dead, and judge the world at the last day. They suppose that the great object of the whole scheme of revelation was to teach men how to live here so as to be happy hereafter; that the particular doctrines they taught, as having a connection with this great object, are those of the unity of God, his universal presence and inspection, his placability to repenting sinners, and the certainty of a life of retribution after death. They suppose, that to be a christian implies nothing more than the belief that Christ and his apostles, as well as all preceding prophets, were commissioned by God to teach what they declare they received from him; the most important article of which is the doctrine of a resurrection to immortal life.

This denomination of Christians argue against the divinity and pre-existence of Christ in the following manner: the scriptures contain the clearest and most express declarations that there is but one God, without ever mentioning any exception in favour of a Trinity, or guarding us against being led into any mistake by such general and unlimited expressions. Exod. xx. 3: "Thou shalt have no other God but me." Deut. vi. 4. Mark xii. 20. 1 Cor. viii. 6. Ephes. iv. 5. It is the uniform language of the sacred books of the Old Testament, that one God, without any assistant, either equal or subordinate to himself, made the world and all things in it, and that this one God continues to direct all the affairs of men. The first book of Moses begins with reciting all the visible parts of the universe as the work and appointment of God. In the ancient prophetic accounts, which preceded the birth of Christ, he is spoken of as a man, as a human creature highly favoured of God, and gifted with extraordinary powers from him, and nothing more. He was foretold, Gen. xxii. 8. to be of "the seed of Abraham." Deut. xviii. "A prophet like unto Moses." Psal. cxxvii. 11: "Of the family of David," &c. As a man, as a prophet, though of the highest order, the Jews constantly and uniformly looked for their Messiah. Christ never claimed any honour nor respect on his own account, nor as due to himself as a person only inferior to the most high God; but such as belonged only to a prophet, an extraordinary messenger of God, to listen to the message and truths which he delivered from him. He in the most decisive terms declares the Lord God to be one person; and simply, exclusive of all others, to be the sole object of worship. He always prayed to the one God as his God and Father. He always spoke of himself as receiving his doctrine and power from him, and again and again disclaimed having any power of his own. John v. 19: "Then answered Jesus and said unto them, verily, verily, I say unto you, the Son can do nothing of himself." John xiv. 10: "The words which I speak unto you, I speak not of myself; but the Father that dwelleth in me, he doeth the works." He directed men to worship the Father; and never let fall the least intimation that himself or any other person whomsoever, was the object of worship. (See Luke xi. 1, 2. Matt. iv.

10.) He says in John xvi. 23, "And in that day ye shall ask me nothing. Verily, verily, I say unto you, whatsoever ye shall ask the Father in my name, he will give it you."

Christ, they say, cannot be that God to whom prayer is to be offered, because he is the high priest of that God, to make intercession for us. (Acts vii. 25.) And if Christ be not the object of prayer, he cannot be either God, or the maker and governor of the world under God. The apostles, to the latest period of their writings, speak the same language, representing the Father as the only true God, and Christ as a man, the servant of God, who raised him from the dead, and gave him all the power of which he is possessed, as a reward for his obedience. In Acts ii. 22, the apostle Peter calls Christ "a man approved of God," &c.; and in Acts xvii. the apostle calls him "the man whom God has ordained." 1 Tim. ii. 5: "There is one God, and one Mediator between God and man, the man Christ Jesus." Had the apostle Paul considered Christ as being any thing more than a man with respect to his nature, he could never have argued with the least propriety or effect, "that as by man came death, so by man came also the resurrection of the dead;" for it might have been replied, that by man came death; but not by man, but by God, or the Creator of the world under God, came the resurrection from the dead. The apostles directed men to pray to God the Father only: Acts iv. 24. Rom. xvi. 27, &c.

This denomination maintain, that repentance and a good life are of themselves sufficient to recommend us to the divine favour; and that nothing is necessary to make us in all situations the objects of his favour, but such moral conduct as he has made us capable of. That Christ did nothing by his death or in any other way to render God kind and merciful to sinners; or rather, that God is of his own accord disposed to forgive men their sins, without any other condition than the sinner's repentance, is declared by the Almighty himself constantly and expressly in the Old Testament, and nener contradicted in the new. Isaiah lv. 7: "Let the wicked forsake his way, and the unrighteous man his thoughts; and let him return unto the Lord, and he will have mercy upon him, and to our God, for he will abundantly pardon." See also Ezek. xviii. 27. This most important doctrine of the efficacy of repentance alone on the part of the sinner, as sufficient to recommend him to pardon with God, is confirmed by Christ himself, Matt. vi. 12: "If ye forgive men their trespasses, your heavenly Father will also forgive you." But above all, the beautiful and affecting parable of the prodigal son, (Luke xv.) is most decisive, that repentance is all our heavenly Father requires to restore us to his favour.

The Unitarians of all ages have adopted sentiments similar to those of Pelagius, with respect to human nature.

Of late years, the Unitarians have been very much upon the increase. They have several societies, in various parts of the country, for the promotion of their principles by the publication of books. In London they have two large and flourishing public societies—The one called "The Unitarian Society for promoting Christian Knowledge and the practice of Virtue, by the distribution of books." This society has lately published "An improved version of the New Testament upon the basis of Archbishop Newcome's new translation, with a corrected text, and notes critical aud explanatory." Among the members of this society are to be found some men of high literary and political character. The other society, established in London, is called the "Unitarian Fund, for promoting Unitarianism by means of popular preaching." The objects of which are stated to be: "1. To enable poor Unitarian congregations to carry on religious worship. 2. To reimburse the travelling and other expenses of teachers who may contribute their labours to the preaching of the gospel on Unitarian principles; and 3. To relieve those Christian ministers who, by embracing Unitarianism, subject themselves to poverty." This society has now several missionaries in various parts of the united kingdom; and its funds are said to be in a flourishing state.

This denomination is now spreading itself in America. There are also some societies in France, and other parts of the Continent, of Unitarian Christians.

UNITY, in poetry. In the drama there are three unities to be observed, *viz.* the unity of action, that of time, and that of place. In the epic poem, the great, and almost only unity, is that of the action. Some regard, indeed, ought to be had to that of time; that of place there is no room for. The unity of character is not reckoned among the unities. The unity of the dramatic action consists of the unity of the intrigue in comedy, and that of the danger in tragedy; and this not only in the plan of the fable, but also

in the fable extended and filled with episodes.

UNIVALVE *shells*, in natural history, a term used to express one of the three general orders of shell-fish; the other two being the Bivalves and Multivalves. See CONCHOLOGY, SHELLS, &c.

UNIVERSALISTS, in church history, were originally those reformers who taught a kind of middle doctrine, between the systems of Calvin and Arminius. They were denominated hypothetical Universalists, because they maintained, that God is willing to shew mercy to all mankind; and because they held, that faith in Christ is a necessary condition, to render them the objects of the divine mercy. These opinions were intended to be opposed to the harsh and cruel notions of Calvin, concerning election and reprobation, on the one hand; and to the opinions of Pelagius, concerning the merit of good works, on the other. The doctrines of the hypothetical Universalists were propagated with success by John Cameron; and were further illustrated and defended by Moses Amyrant, a man of great learning and sagacity. The opinions he maintained, and which produced no small changes in the doctrine of the reformed in France, are briefly summed up in the following propositions:

That God desires the happiness of all men; and that no mortal is excluded by any divine decree from the benefits that are procured by the death, sufferings, and gospel of Christ:

That, however, none can be made a partaker of the blessings of the Gospel, and of eternal salvation, unless he believe in Jesus Christ:

That such, indeed, is the immense and universal goodness of the Supreme Being, that he refuses to none the power of believing; though he does not grant unto all his assistance and succour, that they may wisely improve this power to the attainment of everlasting salvation:

And that, in consequence of this, multitudes perish through their own fault, and not from any want of goodness in God.

It does not, indeed, appear, how this mitigated view of the doctrine of predestination can effectually destroy the heart-appalling thoughts, occasioned by the more open and direct notions of Calvin and his adherents; but such were the opinions taught by the hypothetical Universalists; and they were not without their good effect, in softening down many of the rigours of high Calvinism. But the term Universalists has now obtained a far more extensive signification; as it is used to designate those Christians who hold the doctrine of the future restoration of all men to eternal life and happiness. This sentiment was embraced by Origen in the third century; and, in more modern times, by the Chevalier Ramsay, Dr. Cheyne, Dr. Hartley, and others. The most popular advocates for this doctrine, were Dr. Chauncy and the late Rev. Elhanan Winchester.

Dr. Chauncy held, that as Christ died, not for a select number of men only, but for all men universally, that therefore all men shall finally partake of the benefits of his death; if not in this state of existence, yet in another. He held, that, as a mean, in order to man's being meet for salvation, God will, sooner or later, bring them all to a willing and obedient subjection to his moral government.

This doctrine is maintained by many, not so much, as they say, because it appears to be indicated by some passages of Scripture; but because it is strictly agreeable to the spirit and genius of the dispensation of universal goodness displayed in the Gospel of Christ. They contend, that the doctrine of eternal punishments is not only a cruel and hateful doctrine, but subversive of all proper ideas of the benevolent and wise character of the Almighty, as well as destructive of the true use and design of all punishment. And as punishment cannot proceed from a vindictive spirit on the part of the Almighty, it must be designed so to correct the offenders against his moral laws, as to destroy the necessity of eternal punishment, and restore the sinner to obedience, and a desire after reformation; which reformation, when effected, must render all further punishment both unmerciful and unjust. In defence of this reasoning they say, that the scriptural words rendered *everlasting*, *eternal*, *for ever*, and *for ever and for ever*, are frequently used to express things of limited duration; and that, when they refer to the future state of punishment, they are always to be so understood; because to interpret these words otherwise, would be to reason contrary to the analogy of faith, the ideas of the divine goodness, the design of the Gospel, and the plain dictates of right reason. This doctrine has to boast of having, among its advocates and defenders, the names of Origen and

his disciples; of many of the German Baptists, prior to the reformation; and, in latter times, of Petitpiere, a learned Swiss; of Dr. Rust, Bishop of Dromore, in Ireland; of Archbishop Tillotson; as well as of Bishops Burnet and Newton.

This doctrine is also generally maintained by those Christians who profess the Unitarian faith, whether Arians or Humanitarians. It has, however, been ably opposed by many learned men; though the controversy is now pretty much at rest.

UNIVERSITY. This term signifies the establishment of many colleges in one particular situation, all of which are subject to the same general government, and which are formed by the residence of numerous professors in every branch of science, who teach them to students assembled from all parts of Europe, and particularly the countries possessing those seats of learning.

So many centuries have elapsed since the introduction of this mode of instruction, that each university is desirous to profit by the oblivion involving their origin, in claiming the priority: thus the members of the two universities of Paris and Boulogne assert that they were the first established; nor are those of Oxford and Cambridge less desirous of maintaining their real, or supposed, rights on this head.

As this is not the proper place to enter into an historical account of these vast seminaries of learning, we shall refer our readers, for further information in this particular, to works written expressly on the subject.

We shall now proceed to explain the various component parts of an university; and to accomplish this correctly and minutely, we have had recourse to the Cambridge University calendar, compiled by Mr. Raworth, who says, "The university of Cambridge is a society of students in all and every of the liberal arts and sciences, incorporated (13 Elizabeth) by the name of the chancellor, masters, and scholars. The frame of this little commonwealth standeth upon the union of sixteen colleges, or societies, devoted to the study of learning and knowledge, and for the better service of the church and state." Every college is in itself a corporate body, and governed by its own statutes, which must, however, concur with the general laws of the university, formed by Elizabeth on previous privileges, and confirmed by Parliament, consequently they are the basis of all modern regulations. Each of the colleges send deputies, both for the executive and legislative branches of the government, and the place of their meeting is termed the senate house.

Masters of arts, doctors in divinity, civil law, and physic, who have their names inscribed on the college boards, and are resident at Cambridge, possess votes in the above assembly; and of those there were, in the year 1802, about 940. The senate consists of two classes, which are called regents or non-regents, with a view to some particular offices assigned by the statutes of the university to the junior division. Masters of arts of less than five years standing, and doctors under two, form the regent, or upper house: and it has besides the term of white-hood house, from the circumstance of the members having their hoods lined with silk of the above colour: the remainder constitute the non-regent, or black-hood house: doctors of more than two years standing, and the public orator of the university, are entitled to vote in either of those houses at pleasure; exclusive of which there is a Caput, or council, composed of the vice chancellor, a doctor of each faculty, and two masters of arts, who are representatives of the houses already mentioned. The vice chancellor being a member of the Caput by virtue of his office, his election to the former only takes place annually, on the fourth of November, when the senate choose him from the masters of the sixteen colleges; but that of the Caput occurs after the same interval on the 12th of October, in the following manner: the vice chancellor and the two proctors severally nominate five persons, and from the fifteen thus proposed the heads of colleges and doctors select five, generally preferring the vice chancellor's list.

The officer just mentioned calls the meetings of the senate by a printed notice, which specifies the cause, and must be suspended in the halls of the several colleges three days previously to the time appointed. A congregation of the members thus summoned may proceed to business, and a congregation consists of any number above twenty-six, including the proper officers of the Senate, who are compelled to attend on oath, personally, or by their legal deputies. Exclusive of these casual meetings, there are statutable congregations, for conferring degrees, electing officers, &c. &c. which are held without notice. "Every member has a right," says Mr. Raworth, "to present any proposition, or grace, to the consi-

deration of the Senate; but previously to its being voted by the two houses, it is to be read and approved by the Council, or Caput; each member of which has a negative voice. This custom has seldom been observed, unless something manifestly absurd, or obviously derogatory to the credit of the university, is proposed; insomuch, that nothing has been more common than for a person to give a placet in the Caput, and a non-placet to the same in the body, upon the idea that the Caput should be considered in the light of a committee to prepare the graces in point of form for the subsequent voting; as without some such regulation it might be difficult to take the sense of the Senate upon the real merits of the question." When a grace has passed the Caput, one of two scrutators read it in the non-regent house, and in the other it is read by the senior proctor, after which the vice chancellor dissolves the congregation; the ceremony of reading is repeated in a second congregation; and if a non-placet does not occur, it becomes a statute; on the contrary, if a non-placet is put in by a member of either house, it is put to the vote there, and a majority decides the question.

The senatus consultum decree, or grace, of this learned assembly has the same force and effect as an act of the legislature of Great Britain, which fact is supported by the opinion of the best council, and, "in cases where nothing is enacted in opposition to the laws of the land, neither the statutes of Elizabeth, nor the mandatory letters of succeeding kings, although their authority be apparently strengthened by uninterrupted submission, can stand against the determination of this respectable assembly."

A degree cannot be conferred without passing of a grace for the purpose, which is done with the same formality as if a new law was to be made. This is, however, dispensed with in the single case of a bachelor of arts, as this requires reading in one congregation only, when it is termed a supplicat, and must be signed by the prælector, who thus becomes responsible for the truth of its contents, besides the penalty of being deprived of his privilege of voting in the Senate for two years, or bearing any office in the university, upon discovery of any false assertions in it. Degrees are never conferred, unless the persons receiving them previously sign a declaration, that they are *bona fide* members of the Church of England, as by law established. All the officers of the university, forming the executive part of it, are chosen by the Senate, the principal of whom is the chancellor, who presides in all cases, and to whom is confided the sole power of governing, excepting in cases of mayhem and felony; he is, besides, expected to protect and preserve all the rights and privileges of the institution, and to see that strict and impartial justice is administered in every case to the members; and that all this may be be insured, the office has lately been entrusted to noblemen of the highest rank. Other parts of his official duty are, the convoking of assemblies, the sealing of diplomas, letters of degrees, provisions, &c. given by the university.

The high steward is the next officer in consequence to the chancellor, and to him is granted the power to superintend the trial of students accused of felony, within the limits of the jurisdiction, which is one mile in every direction from the suburbs of the university: he is also empowered to hold a leet, according to the established charter and custom, and is permitted to have a deputy.

The vice chancellor's office is explained by his title; but he acts as a magistrate for the university and county, and must be the head of some college. The regents elect two proctors, who are officers of the peace, and superintend the behaviour and discipline of all the pupils, and may search for and commit to prison those abandoned females who contribute to corrupt the morals of the students at the university. Exclusive of these purposes, the proctors are appointed to attend the congregations of the Senate, when they stand in scrutiny with the chancellor or vice chancellor, to take the open suffrages, verbally, and written, which they read, and finally pronounce the assent or dissent: the graces are read by them in the regent house, where they take the assents and dissents secretly, but afterwards openly declare them. Although there are some particular parts of the duties of these officers which may be considered very unpleasant, yet they must be masters of arts, and are regents by virtue of their office, and are enabled to determine the seniority of all masters of arts at the time of their taking that degree; besides which, they may nominate two moderators, who are then appointed by a grace of the Senate. Those persons act as the substitutes of the proctors in the philosophical schools, and alternately superintend disputations and exercises

there, and the examinations for the degree of bachelor of arts.

Other officers are termed taxors, scrutators, a public orator, a commissary, a registrar, esquire bedells, and librarians. The taxors, similar to the moderators, are masters of arts and regents by virtue of their office, which is to regulate the markets, the assize of bread, the exactness of weights and measures, by the different standards, and to summon all offenders into the commissary's court: the scrutators are non-regents, and their functions are to attend at every congregation, to read the graces in the lower house, where they collect the votes secretly or openly, in scrutiny, when they publicly pronounce the assent or dissent of that house.

The public orator holds an office which is considered as one of the most honourable in the university; he is, in fact, the medium of the senate upon all solemn occasions, reading and recording all communications to and from the senate, and presenting all honorary degrees, accompanied by a suitable speech. The commissary holds his office under the chancellor, and officiates as assessor, or assistant, in the vice-chancellor's court; besides which, he holds a court of record, where all causes are subject to the statute and civil law and custom of the university; and the persons for whom it is held are all privileged, and scholars under the degree of master of arts. The registrar attends himself, or by deputy, all congregations, to give directions, if necessary, for the correct wording of such graces as are propounded, and to draw up any that the vice-chancellor may appoint; to receive them when passed through both houses, and to register them in the archives of the university; exclusive of which, his office requires him to record the seniority of those who proceed annually in the arts or faculties, agreeably to the schedules furnished to him by the proctors.

The esquire bedells attend the vice-chancellor during all public solemnities, preceding him with their insignia of silver maces: they attend, besides, the doctors when present in the regent house, by bringing them to open scrutiny, there to deliver their suffrages, either by word or writing, according to the order of the statute; and to receive from the vice-chancellor and the rest of the Caput the graces, which they deliver to the scrutators in the lower house; when, if granted, they convey them to the proctors in the other. Previous to a meeting, they proceed to every college, with an open summons, either to the senate, or whatever else place may be appointed under the regulations of the university; and, finally, they attend the professors and respondents in each faculty from their several colleges to the schools, collect penalties and fines, and summon all members of the senate to the chancellor's court.

We have now mentioned the different officers of an university in England, with as much brevity as the nature of the subject will permit; at the same time we must observe, that none can be more important in a state, or can more deserve explanation. There are two courts of law in the university of Cambridge: the first of which is the consistory court of the chancellor, where that officer, or in his absence, the vice-chancellor, assisted by some of the heads of colleges, and one or more doctors of the civil law, preside, and administer justice demanded by any member of the university, or afford it to those who conceive themselves injured by them in the cases cognizable by this particular court; there all pleas and actions personal, originating within the jurisdiction of the university, to which a privileged person is a party, and not relating to mayhem or felony, is decided according to the usual course of civil law, by citation, libel, &c. When the cause relates to the sale or purchase of victuals, the chancellor is directed by the charters and customs of the body he governs; and in case they are silent upon the subject, the statutes of England are his guide. The decisions of this court are not absolute, as an appeal may be made to the senate, which appoints three or five doctors, or masters of art, who are empowered to examine, confirm, or reverse the decree complained of.

The other court is the consistory court of the commissary. The commissary, a doctor of the civil law, acts under the authority and seal of the chancellor, and sits as well in the university, as at Midsummer and Stirbitch fairs, there to take knowledge, and to proceed in all causes "ad instantiam et promotionem partis ut supra," the parties, or one of them, being privileged: saving that within the University all causes or suits whereunto the proctors, or taxors, or any of them, or a master of arts, or any other of superior degree, is a party, are reserved solely and wholly to the jurisdiction of the chancellor or vice-chancellor. The manner of proceeding in this court is similar to

that of the preceding, which has a registrar, procurators, and advocates, and a yeoman bedell, as is required in the consistory court. Appeals are also allowed, but in this case it must be made in the first instance to the higher court, and may from thence be removed to the Senate, and the three or five delegates appointed by that body.

The University possesses the right of sending two members to the imperial parliament of the united kingdom, who are chosen by the collective body of the senate. A council, termed the University council, appointed for various purposes, is composed by a grace of the senate, and a solicitor is nominated by the vice-chancellor.

The syndics, chosen from the members of the senate, conduct all special affairs, such as framing laws, regulating fees, and inspecting the library, the printing, buildings, &c. &c. Those of the University press cannot proceed to business unless the vice-chancellor and four others are present in the parlour of the office. All the professors of the sciences are allowed stipends, which are derived from various sources, composed of the University chest, sums from government, or from estates appropriated for that purpose: the whole income of the University being about eleven thousand pounds per annum, including fees for degrees, profits of the printing-office, &c. Of this sum eight thousand pounds is expended annually to officers, professors in the library and schools, the press, in taxes, and charitable donations, the whole under the management of the vice-chancellor for the time being, whose accounts are audited by three persons appointed yearly by the senate.

The Book of Statutes was printed in the year 1785, copies of which are possessed by the vice-chancellor and the proctors, and one is deposited in the public and in the libraries of each college; it consists of the ancient statutes, those of Henry VIII. Edward VI. and those of the first and twelfth years of the reign of queen Elizabeth; "Literæ Regiæ ad Academiam datæ; Interpretationes Statutorum; Senatus consulta sive gratiæ decreta præfectorum; Juramenta et Formulæ." Mr. Raworth says, "the statutes of the twelfth of Elizabeth, and the Senatus Consulta, are those which are chiefly respected at this time. Many of the old statutes, decrees, interpretations, &c. are looked upon as obsolete, some as ridiculous, and others unnecessary in the present establishment; yet what Dr. Bentley observed of Trinity College statutes, during his disagreement with the fellows of that society, might be urged concerning these: "Some are my club, and others my rusty sword, which I can draw upon occasion."

The terms are three in number, Michaelmas term commences on the tenth of October, and terminates the sixteenth day of December; Lent term begins January thirteen, and is concluded on the Friday immediately preceding Palm Sunday; Midsummer term begins one week after Easter day, and ends on the Friday following commencement day, which is invariably the first Tuesday in July. Upon the decease of a member of the senate during the term, and within the University, application is made to the vice-chancellor, and the bell of the University is tolled for one hour, term instantly commences for three days, and for that period lectures and disputations cease.

Most of the statutes made for the government of the sixteen different colleges dictate that the members or fellows of them shall be exclusively Englishmen, and some even prescribe that they must be natives of particular counties and districts; hence an invidious distinction is created between the residents of the northern and southern parts of this island, which, though united for a long time past in political matters, are most completely separated in the pursuit of knowledge; and it is too much to be feared that this circumstance is the real cause of the affected contempt of the degrees and academic honours granted by seminaries of learning in Scotland and Ireland. It is singular that the individuals who founded the colleges at Cambridge and Oxford, should have concurred in this narrow and illiberal conduct almost universally, as they each had a strong sense of religion, which however does not appear to have taught them the best principle of it, brotherly love. As a few of the colleges admit of general competition for fellowships, and the members of the two Universities seem sensible of the injustice and impolicy of such distinctions, we may venture to hope some method will be devised ere long to obviate or remove them. The following regulation applies to all the colleges at Cambridge. "Whosoever hath one English parent, although he be born in another country, shall be esteemed as if born in that county to which his English

parent belonged. But if both parents are English, he shall be reckoned of that county to which his father belonged."

The colleges are thus constituted: The head, by which odd term the master is designated, who is generally a doctor of divinity; but Caius college may be governed by a doctor of physic, and Trinity must have a doctor of laws; the principal of King's is styled provost, and of Queen's president. The fellows are generally bachelors of divinity, bachelors or masters of arts, and others are bachelors and doctors of law and physic, particularly at the two colleges of Trinity-hall and Caius. There is a distinction between the fellows, who are divided into classes, called regular and bye; the latter are considered as merely honorary, never succeeding to college preferment, nor having any concern whatever in the affairs of it, but are allowed an inconsiderable sum annually by their respective colleges, which act as trustees for them; they are denominated Perse Wortley, Yorkshire, Coventry, Platt, Dixie, and Tiverton. Clergymen, who are termed conduits, are employed in the several institutions as chaplains, and perform some of the duties belonging to that office.

There are noblemen graduates, doctors in the different faculties, and bachelors of divinity (who have been masters of arts,) whose names are on the boards, and are all members of the Senate; they reside in the University occasionally, but have no further claim upon a college than the general respect due to their rank in the honours of the former; their charges are inconsiderable for keeping their names on the boards, being about four pounds per annum.

Graduates, neither members of the Senate, nor in statu pupillari, are bachelors of divinity, and denominated four and twenty men, or ten-year men. These are generally clergymen that procure the dignities of the university in addition to their wealth and preferment at an easy rate, without the formalities of an education within its jurisdiction. Oxford does not permit this method of partaking of academic titles, and indeed the possessors of them enjoy but little reputation derived from such at Cambridge. They are tolerated by the statutes of Elizabeth, which allow persons who are admitted at any college, when twenty-four years of age, and upwards, after ten years (during the last two of which they must reside the greater part of three several terms) to become bachelors of divinity, without taking any prior degree.

Bachelors of law and physic sometimes put themselves to the unnecessary expense of keeping their names upon the boards till they obtain the distinction of doctors; bachelors of arts, on the contrary, who are in statu pupillari, and pay for tutorage, whether resident or non-resident, generally keep their names on the boards to evince their desire of becoming candidates for fellowships, or members of the Senate; they may, however, erase their names, and save the expenses of tutorage and college detrimenta, and take the degree of A. M. after the usual time, by inscribing their names a few days before their incepting, and paying a quarter's tutorage; some of these are called bachelors commoners, as they are allowed to dine with the fellows, and when under graduates they were fellow commoners.

The fellow commoners are almost universally the younger sons of titled persons, or the sons of men of ancient families and property; the denomination of those most probably originated from the privilege they enjoy of dining with the fellows. There are some few exclusive rights attached to the rank of fellow commoners, but they chiefly apply to the usages of the hall and chapel, besides which their academic habits are ornamented with gold or silver. Pensioners and scholars pay for their rooms, commons, &c. Those who enjoy scholarships read the graces, lessons in the ritual, &c. Of the sizars it has been observed, they are generally men of inferior fortune, though frequently by their merit they succeed to the highest honours in the University. They usually have their commons free, and receive various emoluments, by which means they are enabled creditably to proceed through their course of education. Most of our church dignitaries have been of this order.

Such is the general outline of an English University, a constitution the work of ages, with numerous perfections, and with very few errors; our confined limits will not permit us to enlarge as we could wish, upon the forms adopted in the arduous undertaking of teaching the sciences and a taste for polite literature united, but we may safely say they seem such as are best calculated for the final purpose, and to excite emulation; and we are supported in this assertion by the fact, that no other Universities have excelled those of England and Great Britain, in the aggregate, in the production of excellent philosophers and respectable di-

vines. Superficial knowledge is held in no kind of estimation at either of our great seminaries, the very essence and causes, as well as effects, must be explored to satisfy the expectations of the various professors, formed by long experience and unexhausted assiduity; a young man must therefore study vigorously, and without relaxation, for two years and one quarter, ere he ventures to appear in a public exercise before the University. The first year is occupied by lectures from Euclid, with the first six books of which he must be thoroughly acquainted, and the principles of Algebra, plane trigonometry, and conic sections. Different colleges have their peculiar systems, but mechanics, hydrostatics, optics, fluxions, and a part of Newton's Principia, with the method of increments, differential method, and similar miscellanea, are the pursuits of the second year; to the third belongs astronomy, the Principia already mentioned, spherical trigonometry, the most difficult and important parts of fluxions, algebra, and geometry: his last term, or the first term of the fourth year, requires all the energies of his mind; he is now more deeply engaged in the arduous conflict of the schools with all his rivals, and preparing himself for the Senate-house examination.

Having completed this course of natural philosophy, we shall next turn our attention to the mode adopted in the second head of academical studies, or the course of moral philosophy in the attainment of this branch. The first year is devoted to Locke and logic, and the two following to Paley, Hartley, Burlamagni, Rutherford, Clarke on the Attributes, and other authors whose writings are of a similar tendency, and those are made the subjects of various orders of lectures in the different colleges; lectures on the chronology, geography, laws, religious rites and customs of the nations which are mentioned in the Old and New Testaments, in some degree derived from Bausobre, but partly from other sources, are also given to promote an accurate knowledge of the foundation of our faith. Unfortunately, although these methods of promoting the studies of the pupils were wisely conceived, and are generally executed with great ability and advantage, there have been instances of neglect and very slight attendance.

The third head includes the belles lettres, or classics, and this, of all the variety of pursuit, seems the most successful in each of the colleges, as every term has an appropriate selection of the best for the lecture room, when extracts from the most approved authors of antiquity, judiciously commented on, and compared with similar passages from modern writers, forms a source of entertainment highly grateful as well as useful. Besides the exertions of the tutor in this particular, the students deliver, either written, or vive voce, compositions in their respective chapels weekly, which may be in the Latin or English languages. The author of the little but valuable work before mentioned very properly observes, that emulation of an honourable kind is excited by prizes and rewards in most of the colleges, and this emulation is not of the dangerous nature too often perceptible in inferior seminaries, as the first man in each year feels his inferiority to those a few years older than himself, and the pre-eminence over his own year in his own college, may receive a most violent check in the collision with the rival heads of his own standing in fifteen other colleges.

UNXIA, in botany, a genus of the Syngenesia Polygamia Superflua class and order. Natural order of Compositæ Discoideæ. Corymbiferæ, Jussieu. Essential character: calyx five-leaved; leaflets ovate; florets of both disc and ray five; seed-down none; receptacle naked. There is but one species, *viz.* U. camphorata, a native of Surinam.

VOICE. The parts employed in the production of the voice are, the trachea, or wind-pipe, by which the air passes to and from the lungs: the larynx, which is a short and cylindrical canal at the head of the trachea; and the glottis, which is a small oval chink between two semicircular membranes, extended horizontally from the entering side of the larynx.

The trachea so much resembles a flute, that the ancients attributed the formation of the voice to the trachea, as much as the formation of the sound to the body of the flute; and till the commencement of the last century, it was generally imagined that the trachea had at least a considerable part in the production of the voice. M. Dodart has established the contrary. He observed, that we neither speak nor sing in drawing in our breath, but only when we expel that which we have inhaled; and that the air thus expelled from the lungs passes through vessels, which increase in size as their distance from the lungs increases; and finally, through the trachea, which is

the most capacious of any: so that the air, instead of being there confined and increasing in velocity, loses it. But the opening, denominated the glottis, being very narrow in comparison with the size of the trachea, the air can never pass through it without acquiring a considerable degree of velocity: so that the air thus compressed and forced on, communicates, as it passes, a vibratory motion to the particles of the two lips of the glottis, which produces that effect on the air which we call sound. The sound thus formed, passes into the cavity of the mouth and nostrils, where it reverberates; and Dodart proves that this reverberation is what principally gives the effect to the voice. The different parts of the mouth, each in its turn, contributes to these reverberations, and modifies them; and it is this mixture of different reverberations, well proportioned to one another, which produces in the human voice a harmony which no instrument can equal. When the parts are defective, much of this pleasure is lost. It is, then, the cavity of the mouth, &c. that more properly answers to the body of the flute; the trachea only furnishes the air, like the sound-board of the organ.

The glottis, by means of different muscles, can be extended or shortened, can be dilated or contracted; and it is these changes which produce all the variety of tone. The narrower the opening the greater the rapidity with which the air passes, and the more acute the sound: hence those who wished to give their voice a very high tone, would suffocate themselves if they continued it sufficiently long; for, as they almost entirely close the glottis, very little air can issue; and they are in a similar situation with those whose respiration is stopped by hanging, drowning, &c. But if the opening of the glottis be too much dilated, the air will pass too easily to produce any vibration: hence those who wish to give their voice too deep a tone, cannot produce any sound.

This power of contraction and dilatation is, perhaps, the most wonderful part of the mechanism of the voice. The diameter of the glottis never exceeds $\frac{1}{10}$th of an inch: now, suppose a person capable of sounding twelve notes (to which the voice easily reaches), there must be the difference of $\frac{1}{120}$th part of an inch for each note. But if we consider the subdivision of notes of which the voice is capable, the motion of the sides of the glottis appears still more minute; for if of two chords, so stretched as to be exactly in unison, one be shortened the $\frac{1}{2000}$th part of its length, a correct ear will perceive the difference of the two sounds; and a good voice will sound the difference, which is only $\frac{1}{100}$th part of a note. But suppose that a voice can divide a note into 100 parts, it will follow that the different openings of the glottis will be 1200 in the $\frac{1}{10}$th of an inch, each of which will produce a sound perceptible to a good ear. But the movement of each side of the glottis being equal, it is necessary to double this number, and the side of the glottis actually divides the $\frac{1}{10}$th of an inch into 2400 equal parts; that each vibration is $\frac{1}{24000}$th part of an inch.

As yet we have simple, unarticulated sound; such as when we sing the notes of a tune without words. Speech is made up of articulated voice; that is, voice modified by the action, not of the lungs, the trachea, or the larynx, but of the throat, palate, teeth, tongue, and lips. Every variation in tone, however, is produced by a variation in the glottis; and in strength, by the action of the lungs: so that all the parts of this complicated mechanism are continually employed. Articulation begins when the voice has passed the larynx. The simplest articulate sounds are those which proceed from an open mouth: they are so little modified, that they are called in some other languages by the term voice; and in our own, from a derivative of the same word. In transmitting these, the apertures of the mouth may be pretty large, or somewhat smaller, or very small; which produces one set of the variations of vowel sounds: besides, in passing through the open mouth, the voice may be gently acted upon by the lips, or by the tongue and the palate, or by the tongue and throat: and hence another source of variation; and thus nine simple vowel sounds are produced. When the voice, in its passage through the mouth, is totally intercepted, or strongly compressed, there is formed a certain modification of articulate sounds, which is called a consonant. Silence is the effect of a total interception; and indistinct sound, of a strong compression: hence a consonant is not of itself a distinct articulate voice; and its influence, in varying the tones of language, cannot be perceived, unless it be accompanied with an opening of the mouth, that is, by a vowel sound.

Such is the nature of the mechanism of the human voice; so complicated, yet so simple: and when we consider the great variety of motions necessary to be performed by every one who speaks with common fluency, instead of surprize that children are so long before they can articulate, and express a chain of ideas by words, we shall see ground for admiration, that this most invaluable acquisition is made so early. The fact appears to be, that the powers of imitation are at that period the principal source of improvement; and the organs being then more capable of the requisite variation of flexure than in the later periods of life, sounds are acquired (not indeed without much trouble, and almost incessant exertion), which at the age of manhood baffle the best-directed exertion.

VOIDED, in heraldry, is understood of an ordinary whose inner or middle part is cut out, leaving nothing but its edges to show its form, so that the field appears through it. Hence it is needless to express the colour or metal of the voided part, because it must of course be that of the field. The cross voided, differs from the cross fimbriated, in that the latter does not show the field through it, as the other does; and the same obtains in other ordinaries.

VOIDER, in heraldry, one of the ordinaries whose figure is much like that of a flask of flanch, only that it doth not bend so much.

VOLANT, in heraldry, is when a bird in a coat of arms is drawn flying, or having its wings spread out.

VOLCANIC *formations*. The products of volcanoes are ejected stones and ashes; lava and water mixed with ashes, of a slimy consistence: the first order comprehends the ejected stones and ashes; the second, the different kinds of lava; and the third, the matter of muddy eruptions. The stony ejections are those which are always thrown from the summit of the volcano: they accumulate and form the crater, which is a funnel shaped hollow. Mineralogists have enumerated among ejected stones: 1. Granular lime-stone, which is said to contain tremolite, pistacite, olivine, augite, Vesuvian, melanite, sommite, and hornblende; 2. Granite; 3. Mica-slate; 4. Green-stone; and, 5. Sand-stone. Lava consists of two sub-species, *viz.* slag-lava and foam-lava: these do not extend far, having in general flowed, in streams of considerable height, into hollows, and gradually consolidated during its course. Matter of muddy eruptions comprehends volcanic-tuff, which is composed sometimes of ashes, sometimes of vesicular lava, and probably some particular chemical formations. See VOLCANOES.

VOLCANOES, mountains which emit ignited matter and smoke through apertures, communicating with cavities in the depths of the earth, where eternal fires are situated, that burn with more or less force, as they are influenced by causes which it is impossible should ever be explained by actual observation, but that may be conjectured with tolerable success from experiments. Such have been made by many naturalists (who deserve every praise for their assiduity and research), though not with an accuracy that distinguishes those of the celebrated Abbe Lazarro Spallanzani, professor of natural history in the university of Pavia: this gentleman, though far advanced in life, acted with a vigour and hardihood seldom found even in youth, and braved danger and death, in a thousand horrid forms, in pursuit of his favourite object, the elucidation of the phenomena of volcanic fires. To whom, then, can we with more propriety have recourse, in our attempt to explain their causes and effects? The Abbe observed, in the course of his various examinations of craters, that volcanoes emit vast quantities of gas; and he found that stony substances were invariably, when completely heated by the subterraneous fire, rarified, inflated, and rendered cellular, by their elasticity; which effect is observable in numbers of lavas, glasses, and enamels, ejected during eruptions: and he discovered, in addition, that their violence continually raised the liquified matter from the interior of the craters to their very borders, over which it flowed at each impulse.

He was at the same time equally attentive to the nature and force of the fire which acts in the bowels of volcanic mountains; and, in the course of his researches, discovered that Vesuvius, Ætna, the Eolian Islands, and Ischia, are immense mountains, composed of rocks that have been liquified, and even vitrified, by the violence of the subterraneous conflagration. "What fire," he exclaims, "can *we* produce equivalent to these effects!" Humble, however, as all experiments appear with our limited means, this venerable philosopher justly thought imperfect knowledge of volcanoes preferable to contented ignorance, and, undismayed by the magnitude of the

object, proceeded to ascertain, as far as possible, what man is permitted to know on this terrific subject. "I have," he observes, "discovered, that the fire of the glass-furnace will completely refuse the vitrifications, enamels, pumices, scoriæ, and lavas, of these and other volcanic countries. The same will, in like manner, vitrify rocks congenerous to those from which these mountains have originated, by the means of subterranean conflagrations. A less intense fire, on the contrary, produces no such effect on any of these substances. Determined to exercise the most rigorous research, and to ascertain, with the greatest possible precision, the exact degree of heat requisite to produce the above effects, he had recourse to the pyrometer of Wedgwood, which he compliments and praises, by saying nothing could be better adapted for his purpose.

The terrific appearance of a volcano in eruption is so appalling, so grand, and altogether so wonderful, that it is by no means astonishing the world should suppose the vast volumes of smoke, ignited matter, and stones, hurled into the air with inconceivable violence and rapidity, exclusive of the torrents of liquified substances which roll down its sides in solemn and destructive majesty, were caused by more powerful fires than those man has been permitted to kindle; in saying the world, we wish to be understood as meaning those who have seen or read of eruptions without examining the subject further. Of natural philosophers, there were many who coincided with this general opinion; and others have maintained the direct contrary supposition, asserting, that volcanic fires are extremely feeble in their operations: following the example of Spallanzani, we shall give the substance of the arguments of each, in order that the reader may draw his own conclusion. It is evident that we must have recourse to the same rule for ascertaining the intensity of volcanic fires, which we make use of in measuring the effects of our fires when in activity on bodies immersed in them; and we have already mentioned, that Wedgwood's pyrometer answers for the purpose, as nearly as the nature of the pursuit will permit: but long before the invention of this instrument, attempts were made to attain the object in question, particularly by the academicians of Naples, who, at the time of the great eruption in the year 1737, made an experiment on the lava near the Torre del Greco, in a valley where it had accumulated; and though it had ceased its motion several days, yet retained a heat equal to that of red-hot iron. They formed a piece of lead, weighing two ounces, in a conical shape, which they placed on the red-hot surface of the lava; the metal became soft in two minutes and a half, and in one minute more it was completely melted; another piece of lead, in every respect exactly similar, was then deposited on a plate of red-hot iron, rendered so by burning coals beneath it, when they found that it required six minutes and a half to soften, and seven and a half to liquify it. Water, placed on the lava, boiled furiously in three minutes, and on burning coals, one minute later. Judging from these facts, the academicians concluded that lava, though exposed to the external air for some days, and consequently far less intensely heated than when first issuing from the crater, was much mere fiery in its nature than red-hot iron or burning coals: but this conclusion is obviously incorrect; because the plate of iron, being surrounded by air, could not acquire all the heat which was applied to it; neither was it fair to rest an opinion of this description upon a result produced by means so unequal, as a vast depth of ignited matter opposed to a thin plate of iron.

Prince Cassano, a member of our Royal Society, produced an instance of the violent heat of the lava which issued from Vesuvius, to that learned body, which seems more to the purpose than that of the Academicians: the torrent of lava alluded to, approached a convent of Carmelites; every combustible article was immediately consumed, even before the mass came into contact with it; and the heat was so excessive, that the glasses standing upon a table in the refectory, were instantly reduced to shapeless pieces of that useful material: this circumstance produced an experiment, attended with the same consequences, which was the fastening of a fragment of glass to the end of a long stick, and holding it near the lava, when, at the close of four minutes, it became a mere paste. A fact of the same nature is mentioned by Professor Bottis, in his account of the eruption of Vesuvius, in the year 1667. Now, though this effect may be produced by suspending a piece of glass in the air of a glass furnace, it must be admitted, that this being in a state of full activity, and the heat excited to the utmost, by every human means, is not a just compa-

rison with a body of lava far removed from the spot where it acquired its heat, which must, without doubt, be at that spot ten times greater; hence it appears decidedly clear, that the internal fires of Vesuvius far exceed that of our glass-furnaces.

Bottis seems to have been one of the first naturalists who observed the rapidity with which the fire of Vesuvius causes fusion; that gentleman mentions, in his description of the eruption of July, 1779, that he saw a small hill, composed of porous lava and scoriæ, inclosing an inconsiderable gulph, that produced a noise like that of oil or fat, in the act of boiling or simmering over a fire; this appearance induced him to examine it, when he found it contained matter in fusion, which immediately heated red-hot, and then melted fragments of lava or scoriæ, thrown into it. As Spallanzani acknowledges that his efforts to melt similar substances required half an hour, we must admit, that this is another proof of the superior heat of volcanic fires. A still further evidence of their extreme heat is, the great length of time which lavas retain it. In the year 1737, some labourers were employed to remove the lava which had crossed a road, and although a month had elapsed from the period of the eruption, they were compelled to desist, as the heat softened their tools beyond the possibility of using them. Sir William Hamilton also found it very great, and, dropping some pieces of wood into the fissures of a mass, situated four miles from the volcano, they immediately took fire; but Spallanzani illustrated this fact more decidedly, by passing a body of lava near the upper crater of Ætna, visibly red hot, even in full day-light, which had flowed from the mountain eleven months before.

It is supposed, that the volcanic fires of Iceland are very active and powerful, which is inferred from the incompetency of the blow-pipe to fuse the glass issuing from them. Vallisneri, describing a new volcanic island, which rose from the sea in the year 1707, near Santorine, asserts, that the sea in its vicinity became so violently heated, that vast numbers of fish perished, and were actually boiled; and it is well known that the same cause melted the pitch in the seams of ships' bottoms, and occasioned their leaking: this modern fact is corroborated on the authority of Strabo, who declares, that the sea was observed to boil for four days, between Thera and Therasia. The complete fluidity of lava is another convincing proof of the excessive heat prevailing in the centre of volcanoes. M. Bottis produces two instances derived from Vesuvius in 1771 and 1776, which demonstrate that this fiery mass assumes a state of liquidity, almost equal to water: the Professor mentions four hills to have arisen suddenly in the first case near the aperture whence the larva proceeded, and from three of those in the shape of cones, issued streams of the melted matter, exactly resembling fountains of water. During the eruptions of the latter year, fresh lava, rushing from the crater, fell upon that of 1771, and rebounding from it into the air, there congealed in various figures capriciously ramified, and terminating in thin sharp points like needles. A circumstance observed by Sir William Hamilton, Count de Wilzeck, Cardinal Herzan, and the Archduke Maximilian of Austria, in the year 1775, seems to establish the fact, that the fluidity of the lava has been such at times, as to separate into portions, which, being thrown up from the crater, fell again near it, in a state so soft, that a guide who assisted in conducting these illustrious visitors, perceiving a fragment, passed his stick through it, and presented it thus to the prince, who ordered both to be deposited in his private museum; this, however, seldom occurs, at least the indefatigable Spallanzani never discovered these fragments flattened or indented, as if they had fallen on some hard substance when in the consistence of paste.

With respect to the rapidity of its motion, this must greatly depend upon the quantity ejected, as well as the intensity of its heat: when an opportunity happens for attentive observation, the lava has been known to rise suddenly to the summit of the crater, and as suddenly overflowing its boundaries, rush down in various rivulets of fire; indeed Bottis compares it to "a liquor which boils in a vessel, and rises and overflows the edges of that vessel from the violence of the heat." The lava from Vesuvius, issuing in 1751, flowed over the space of twenty-eight palms in one minute; in 1754, it proceeded in two branches, at the rate of thirty feet in forty-five seconds, and afterwards uniting, at thirty-three feet in fifty seconds: to these facts may be added the testimony of Sir William Hamilton, who thought its velocity in 1765 equal to that of the Severn, at the passage near Bristol. It may, however, be necessary to observe, that the fluidity of the matter does not always alone occasion its motion, which may be accelerated by a great de-

scent, or the violent pressure of fresh lava constantly issuing from the source, particularly as lavas are known to harden when actually moving, so as to produce a sound when struck, and to bear stones thrown on their surface; but to place this fact beyond a doubt, Sir William Hamilton informs us, that himself and others, following the example of Mr. Jaimineau, British consul at Naples, actually crossed a moving mass above fifty feet in breadth; yet, even thus circumstanced, those dreadful rivers of fire have been known to reach the sea eighteen, twenty, and even thirty miles from their commencement.

The arguments used to establish an idea, that fires excited and maintained by human means exceed those of volcanic origin in force, lie in a very small compass indeed; they are derived from observing, that some furnaces "vitrify lavas more decidedly than volcanoes, and melt schorls which remain perfect in the former." Dolomieu places this supposition in a clear point of view, in a memoir published by him of basaltes. "I shall again repeat," observes this celebrated French naturalist, "what cannot be too frequently inculcated, that lavas are not vitrifications; their fluidity is similar to that of metals reduced to fusion; it does not change the order and manner of being, of the constituent parts of the lavas. When they cease to flow, they resume, like metals, the grain, texture, and all the characters of their primitive base; effects which we cannot produce upon stones in our furnaces, since we know not how to soften them by fire, without changing the manner in which they are aggregated. The fire of volcanoes has not that intensity which is supposed, and produces its effects rather by the extension and duration of its action than by its activity."

Arguing upon these various facts, and remarks of his own leading to the same point, Spallanzani candidly acknowledges, that he had been more than once inclined to believe, that our fires possessed more energy than those of volcanoes; a number of experiments, however, induced him to say, that "these facts prove, first, that it is not always true, that volcanic fires are insufficient for the fusion of shorls; secondly, by the vitrification of the garnets, they confirm the powerful activity of those fires; thirdly, that those fires operate in a manner in some measure unknown to us; since, at the same time that they vitrify the garnets, they leave the base in which they are included in a state perfectly recognizable, notwithstanding that the former are refractory to the fire of the furnace, while the latter is easily fusible." It has been a generally received assertion, that volcanoes emit flame during eruption, and that flowing lavas are attended by the same accompaniment of fire; this supposition is erroneous, as may be proved by referring to the works of Serao, Father Torre, Bottis, and Sir William Hamilton, all of whom will be found to have omitted the observation of flames. The first expressly says of the lavas of Vesuvius, "that when seen by night, at any distance, they emit a light, not shining, like a bright flame, but of a dead kind, like that of red-hot substances which burn without flame;" and the last mentions, that he has "observed upon mount Vesuvius, that soon after a lava has borne down and burned a tree, a bright flame issues from its surface; otherwise I have never seen any flame attending an eruption:" adding, that the light reflected on the smoke, as it rises from the crater, by the raging of the fire in the gulph beneath, is frequently mistaken for flame. Spallanzani confirms the opinion of these accurate observers, and declares he never saw flame in, or proceeding from, any of the craters he examined.

Faujas thought it not improbable that fire united with water may produce some of those combinations of which we know not the origin; he says on this subject, "I almost incline to be of opinion, that the aqueous fluid, raised to a degree of ebullition and incandessence, of which our feeble furnaces can give us no idea, sometimes concurs with the inactive and concentrated fire which exists in the immense volcanic caverns, and that from this concurrence results a multitude of combinations hitherto unknown to us, which take effect on the stones and earths that remain perhaps whole ages in these burning gulphs, where the fire, intent to destroy, has for its adversary the water, which incessantly creates and opposes to it all the forms and modifications of which the matter is susceptible."

It will now be necessary to mention some of the effects of gas in the operations of these fierce internal fires: it is well known that their violent efforts to reach the surface of the liquified masses contained in craters causes it to rise suddenly from the bottom, completely filling their whole circumference, and at length forcing it over the sides in destructive

streams, which overwhelm in their passage every object, either natural or artificial. Spallanzani made ten distinct experiments, in order to obtain some idea of the nature and effects of gas as exhibited by volcanoes; for this purpose he made use of different lavas, enamels, and glasses, ejected from them, and the consequence was, a conviction that the bubbles and inflations of various dimensions, observable in these substances, are not produced by the action of any permanent gas, "but by that of an aëriform fluid, produced by the excessive attenuation of those same products, in consequence of heat." Dr. Priestley made similar expements, which differed in some degree from those related by the above celebrated Italian naturalist. The doctor fused $4\frac{1}{5}$ ounces of lava from Iceland in a sandstone retort, and obtained twenty measures of air, half of which, at the commencement of the process, was carbonic acid gas, and the remainder, in purity 1.72, extinguished a candle; between the interstices of this lava was a sand, which the operator could not separate from it. Five ounces and a half of Vesuvian lava produced thirty measures of air, with a slight appearance of carbonic acid gas, the rest was azotic gas, from the degree 1.64 to 1.38, with respect to what came last. On cooling, the residue broke the retort by its excessive inflation.

Without entering into an examination of the difference of opinion existing between these philosophers, we shall give an extract from the works of Spallanzani, that fully illustrates this part of our subject; "I shall," he observes, "now proceed to enquire what part this aëriform vapour acts in the eruptions of volcanoes. Where it exists in the depths of a volcanic crater, abundantly mixed with a liquid lava violently urged by subterranean conflagrations, I can easily conceive, that by its energetic force it may raise the lava to the top of the crater, and compel it to flow over the sides and form a current. Art can imitate this grand operation of nature on an infinitely less scale. I placed in a glass furnace a cylindrical crucible, one foot high, and two inches and a half in breadth, which I filled half full with one of those volcanic products which most inflate and boil in the fire. After some hours, I observed that the liquid matter began slowly to rise, and afterwards to rise higher, until it at last overflowed the edges of the crucible, forming small streams down its sides, which, when they reached the plane on which the crucible stood, gave origin to small currents, if that plane was at all inclined. When I put more of the same product into the crucible, the currents became larger. If the plane was then taken from the surface, and the small currents, thus produced, examined, they were found full of minute bubbles, as was likewise the matter which remained in the crucible. This curious experiment I made with several glasses and volcanic enamels, as also with a variety of cellular lavas, and always with the same success."

Judging from the result of the above trial, it cannot be doubted that a similar elastic vapour, collecting in vast quantities under the surface of the earth, must, upon meeting with resistance in its passage, produce loud noises resembling thunder, and local tremblings of the surrounding earth, besides forcing its way upwards through super-incumbent lava: other experiments made by Spallanzani, however, seem to prove that it must be another cause which expels the fiery matter with violence out of craters, as the mattrasses he used broke without noise, and without ejecting or scattering the substance; and particularly, as the escape of gases has been frequently ascertained by the hissing sounds attending eruptions; unfortunately, though those vapours offer themselves to examination, it would be impossible to collect any part of them without exposing the life of the experimentalist to almost certain destruction; we must therefore admit their existence, and conjecture must supply the rest.

It will be recollected that all volcanoes, at present in a state of activity, are surrounded by, or situated very near, the sea, hence it appears clear, that the agency of that body is extremely powerful in promoting the violence of their eruptions, by rushing at uncertain intervals, and from unknown causes, through the caverns of the earth, upon the ever enduring fires there existing; and this supposition is supported by the fact, which has been repeatedly observed, of the sudden retiring of the sea immediately preceding a violent explosion from a crater, the certain consequence of a rapid diminution of water on the shore. Little need be urged to prove the immediate and vehement separation that takes place upon the collision of fire and water, and of the force of steam thus produced; one instance, however, may be safely cited, which will place this supposed collision in a true light, and

is extracted from the fourth volume of the "Memoirs of the Academy at Bologna." A bell of enormous dimensions had been ordered to be cast at Modena, and preparations of the usual description were made under a spacious portico. After the metal had been completely melted, it was led into the mould, situated at a small depth under the pavement, through a small channel; the burning fluid had no sooner entered the mould than a dreadful explosion took place, which resembled in every particular the horrid effects of springing a mine; a deep hole was sunk in the earth, the metal, the mould, and every material of the portico above it, were scattered in the air, and several persons were killed and severely wounded; if such were the immediate consequences of a trifling degree of moisture remaining in the sand which composed the mould, it may be naturally inferred, that a body of water, meeting with subterraneous fires, is capable of producing eruptions and earthquakes. It seems, however, extremely probable from experiments, that this effect principally arises from the insinuation of water under or below the surface of the sides of those fires, as it has been ascertained that water thrown upon fire evaporates without much violence, and yet, if the vapour thus generated is confined by super-incumbent earth, or rocks, its struggles for a vent must occasion the violent disruption of those parts; the event is different on pouring water on melted tin, which is the only metal that is separated by this means, so as to render it a dangerous operation to the experimentalist.

Spallanzani concludes many curious and interesting observations derived from experience, by saying, "from this series of experiments I think we are authorised to conclude, that when a quantity of water falls on the burning crater of a volcano, it has not the power of producing explosions; but that the latter on the contrary are very violent when the water penetrating below, reaches the conflagration; when suddenly reduced to vapour by the heat, it finds no room for its dilatation; or when it insinuates itself laterally among the liquified matters; of which we have a satisfactory proof in the explosion of the lava, violently forced from the containing vessel, on the introduction of water into a cavity made in it."

From what has been already said, a tolerable conception may be formed of the probable causes of volcanic eruptions: it now remains for us to add a concise narrative of their visible phenomena, and for this purpose we find ample materials furnished by Spallanzani, whose ascent of Stromboli deserves every praise for its courage, though we cannot help condemning him for the exercise of very daring temerity. The visit we allude to was made in 1788, when the appearance of the mountain was bifurcated, and the crater situated at some distance from the summits, from both of which the operations within it are distinctly visible, and from those the height of the ejections may be ascertained, with tolerable accuracy. During violent internal agitation the matter appears to ascend half a mile and more, but when the mountain is in actual eruption, the scattered fragments prove, that the impelling force is very greatly increased. After having attentively examined the crater from the summit above alluded to, Spallanzani approached the crater, where he found that the explosions succeeded each other so rapidly, that they might almost be said to occur without any intervals of quiet; but they varied in their force; the matter, in some instances, not rising more than fifty feet, and falling again into the crater; and in others it was elevated half a mile; the sounds, consequently, are proportionably loud, or the reverse, and resemble a hissing noise; the fragments of lava were actually fluid during their progress, which was evident from their globular shape, and becoming hard before they fell upon the sides of the mountain, that form is preserved.

The exhalations exhibited a thick cloud several miles in extent which were strongly impregnated with sulphur; this cloud was impenetrable by the beams of the sun, and appeared very black in the midst, but white on the edges, and was, in all probability, a mile in depth. The vapour thus floating from the mountain was derived from three distinct sources, though doubtlessly produced by the same cause in the first instance: when an ejection of lava took place, it was always accompanied by a cloud of grey smoke from the crater; to the west of that spot were a number of obscure apertures, each of which sent forth a volume of similar vapour; and to the east, a vast cavern emitted a column at least twelve feet in diameter, extremely black and dense.

"Not satisfied with the observations I had already made," observes Spallanzani, "my curiosity impelled me to attempt further discoveries. From the pointed rock on which I stood, I could only see the edges of the inside of the crater. I consider-

ed, therefore whether it might not be possible to obtain a sight of the lower parts likewise; and looking round me, I perceived a small cavern hollowed in the rock, very near the gulph of the volcano, into which the rock above prevented the entrance of any burning stones, should they be thrown so far. It was likewise so elevated, that from it the crater was open to my view. I therefore hastened to take my station in this cavity, taking advantage of one of the very short intervals between the eruptions. To my great satisfaction, my expectations were completely fulfilled; I could here look down into the very bowels of the volcano, and truth and nature stood as it were unveiled before me." Thus situated in probable safety, the intrepid Spallanzani saw the following wonders.

The crater he found to be of a circular form, with edges composed of a chaos of sand, scoriæ, and lava; and he imagined the circumference to be about three hundred and forty feet. Similar to all other craters, that of Stromboli assumes the shape of a truncated inverted cone, the sides of which, from east to south, were gently inclined, but the remainder very steep. Many parts of this internal descent appeared to be incrusted with yellow substances, which he supposed to be the muriate of ammonia (sal ammoniac) or sulphur.

Fluid lava, resembling melted brass, red-hot, and liquid, filled the crater to a certain height, and this matter appeared to be influenced by two distinct impelling powers, the one whirling and agitated, and the other upwards; at times it rose rapidly, and when the surface had reached within thirty feet of the edges of the crater, an explosion took place like a short clap of thunder, and at the same instant a portion of the lava was hurled with inconceivable swiftness into the air, which was as instantaneously separated into numerous fragments, and those were accompanied by a copious discharge of sand, ashes and smoke. Immediately before the eruption occurred, the lava appeared inflated, and large bubbles, some several feet in diameter, rose and burst, the detonation followed, and the lava sunk, till a repetition of this operation was commenced; during the rising, a sound issued from the crater like that produced by a liquid boiling violently in a cauldron. Many of the eruptions were so inconsiderable, that their effect could not be visible at a small distance from the mountain; in those the fragments constantly fell back into the gulph, with a sound, on their collision with the great mass of matter, similar to that produced by water when forcibly struck with flat staves: in the greater explosions, many of the pieces returned into the crater, some falling on the sides and rolling down, but many descended a precipice, formed by one side of the mountain, to the sea.

The pieces of scoriaceous lava as they moved in the air, retained their red-hot appearance, though the sun shone clear; many of them came in contact during their progress, and, according to the degree of heat they possessed, they adhered or were broken. The smoke seemed to be foreign to the lava, as none attended the fragments thrown into the air, and that which escaped passed through fissures, and at the moment the lava burst. According to Spallanzani's conjectures, the crater may be about twenty-five or thirty feet in depth, when the lava is raised to its greatest height, and upon its subsiding, forty or fifty. There are no visible marks of its ever having overflowed so as to descend like those of Ætna and Vesuvius.

"Though the ejections of the larger and heavier stones have short intermissions, those of the lesser and lighter have scarcely any. Did not the eye perceive how those showers of stones originate, it would be supposed that they fell from the sky: the noise of the more violent eruptions, resembling that of thunder, and the darkness occasioned by the mounting cloud of smoke, present the image of a tempest. . . .

While this naturalist was employed in intense observation, the eruption suddenly ceased, the lava sunk to a greater depth than usual, and remained thus depressed; the fierce light subsided, and at the same instant the various streams of smoke, issuing before silently from the apertures west of the crater, began to rush forth with a loud hissing noise, and the apertures to shine with a bright colour of fire. "I know nothing," says Spallanzani, "to which the sound produced by the issuing of these fumes can be more properly compared than the blowing of large bellows into a furnace by which metals are melted; such as I have seen at Zalatna, in Transylvania, and Schemnitz and Kremnitz, in Hungary, except that those volcanic bellows roared a hundred times louder, and almost deafened the ear."

We cannot conclude this article more properly than by giving an account of the crater of Ætna, as it was examined by the above author, to which he ascended with

equal danger and difficulty, and where he was compelled to sit nearly two hours ere he could commence his observations: he then says, "I viewed with astonishment the configuration of the borders, the internal sides, the form of the immense cavern, its bottom, an aperture which appeared in it, the melted matter which boiled within, and the smoke which ascended from it. The whole of this stupendous scene was distinctly displayed before me; and I shall now proceed to give some description of it, though it will only be possible to present the reader with a very feeble image, as the sight alone can enable him to form ideas at all adequate to objects so grand and astonishing. The upper edges of the crater, to judge by the eye, are about a mile and a half in circuit, and form an oval, the longest diameter of which extends from east to west. As they are in several places broken, and crumbled away in large fragments, they appear as it were indented, and these indentations are a kind of enormous steps, formed of projecting lavas and scoriæ. The internal sides of the cavern, or crater, are inclined in different angles in different places: " on the west the inclination is gentle; on the north the steepness increases; and from this point to the south east the descent becomes more sudden, till, where the observer stood, they were almost perpendicular. The funnel,shape, however, still prevails, as in every other instance, and the surface was extremely rugged, and strewed with concretions of an orange colour, which proved to be the muriate of ammonia; and it is very probable that the numerous stripes of yellow on the nearly horizontal plain at the bottom may be the same substance. "In this plain, from the place where I stood, a circular aperture was visible, apparently about five poles in diameter, from which issued the larger column of smoke, which I had seen before I arrived at the summit of Ætna. I shall not mention several streams of smoke which arose like thin clouds from the same bottom, and different places in the sides. The principal column, which, at its origin, might be about twenty feet in diameter, ascended rapidly in a perpendicular direction while it was within the crater; but when it had risen above the edges inclined towards the west from the action of a light wind; and when it had risen higher, dilated into an extended but thin volume. This smoke was white, and being impelled to the side opposite to that on which I was, did not prevent my seeing within the aperture; in which, I can affirm, I very distinctly perceived a liquid ignited matter, which continually undulated, boiled, and rose and fell, without spreading over the bottom. This certainly was the melted lava, which had arisen to that aperture from the bottom of the Ætnean gulph."

Being favourably situated for observing the effects of external violence on the liquid matter within the aperture, the abbe rolled large fragments of lava down the side, which, entering the opening, produced a sound resembling the sudden immersion of a heavy substance in a thick tenaceous paste. In performing this experiment, the effect was multiplied by the stones loosening others in their passage, some of which fell on the plane; those rebounding, even when very large, caused a sound extremely different from the others that struck the liquid lava: this circumstance proves, that, though the bottom may be a comparatively thin covering of the gulph, it is capable of great resistance. We shall proceed with a short notice of

Volcanoes *in the moon*. As the moon has on its surface mountains and valleys in common with the earth, some modern astronomers have discovered a still greater similarity, *viz.* that some of these are really volcanoes, emitting fire as those on earth do. An appearance of this kind was discovered some years ago by Don Ulloa in an eclipse of the sun. It was a small bright spot, like a star, near the margin of the moon, and which he at that time supposed to have been a hole, with the sun's light shining through it. Succeeding observations, however, have induced astronomers to attribute appearances of this kind to the eruption of volcanic fire; and Dr. Herschel has particularly observed several eruptions of the lunar volcanoes, the last of which he gives an account of in the Philosophical Transactions for 1787. "April 19, $10^h\ 36^m$, sidereal time. I perceive (says he) three volcanoes in different places of the dark part of the new moon. Two of them are either already nearly extinct, or otherwise in a state of going to break out; which perhaps may be decided next lunation. The third shows an actual eruption of fire or luminous matter. I measured the distance of the crater from the northern limb of the moon, and found it $3' 57.3''$: its light is much brighter than the nucleus of the comet which M. Mechain discovered at Paris the 10th of this month.

"April 20, $10^h\ 2^m$, sidereal time. The

volcano burns with greater violence than last night. Its diameter cannot be less than 3″, by comparing it with that of the Georgian planet: as Jupiter was near at hand, I turned the telescope to his third satellite, and estimated the diameter of the burning part of the volcano to be equal to at least twice that of the satellite: whence we may compute, that the shining or burning matter must be above three miles in diameter. It is of an irregular round figure, and very sharply defined on the edges. The other two volcanoes are much further towards the centre of the moon, and resemble large, pretty faint nebulæ, that are gradually much brighter in the middle; but no well defined luminous spot can be discerned in them. These three spots are plainly to be distinguished from the rest of the marks upon the moon; for the reflection of the sun's rays from the earth is, in its present situation, sufficiently bright, with a ten feet reflector, to show the moon's spots, even the darkest of them; nor did I perceive any similar phenomena last lunation, though I then viewed the same places with the same instrument.

"The appearance of what I have called the actual fire, or eruption of a volcano, exactly resembled a small piece of burning charcoal when it is covered by a very thin coat of white ashes, which frequently adhere to it when it has been some time ignited; and it has a degree of brightness about as strong as that with which such a coal would be seen to glow in faint day-light. All the adjacent parts of the volcanic mountain seemed to be faintly illuminated by the eruption, and were gradually more obscure as they lay at a greater distance from the crater. This eruption resembled much that which I saw on the 4th of May, in the year 1783, but differed considerably in magnitude and brightness; for the volcano of the year 1783, though much brighter than that which is now burning, was not nearly so large in the dimensions of its eruption: the former seen in the telescope resembled a star of the fourth magnitude as it appears to the naked eye; this, on the contrary, shows a visible disc of luminous matter very different from the sparkling brightness of star light."

VOLKAMERIA, in botany, so named in memory of John George Volkamer, physician at Nuremburgh, a genus of the Didynamia Angiospermia class and order. Natural order of Personatæ. Vitices, Jussieu. Essential character: calyx five-cleft; corolla segments directed the same way; drupe two-seeded; nuts two-celled. There are eight species.

VOLITION. See WILL.

VOLUNTARY, in music, is an extempore performance upon, or a composition written for, the organ, and serving to relieve and embellish divine service.

VOLVOX, in natural history, a genus of the Vermes Infusoria class and order. Worm invisible to the naked eye, simple, pellucid, spherical. There are nine species. V. sphærula is, as its name denotes, spherical, with similar rounded molecules. It is seen in stagnant waters. Body composed of about sixty pellucid homogeneous transparent or greenish-yellow points, moves slowly about a quarter of a circle from right to left, and then back again from left to right.

VOLUTA, in natural history, a genus of the Vermes Testacea class and order. Animal a limax; shell one-celled spiral; aperture without a beak, and somewhat effuse; pillar twisted, or plaited, generally without lips or perforation. There are nearly two hundred species in sections. A. aperture entire; B. subcylindrical emarginate; C. oboval effuse emarginate; D. fusiform; E. ventricose; spire papillary at the tip. In the first section is V. auris midæ; shell contracted, oval, oblong, with rugged spire; pillar two-toothed. It inhabits India, in marshy woods and swamps, and very much resembles an helix; about four inches long; shell brown, solid, wrinkled, or striate; spire large, with from six to nine whorls, each terminated by a granulated band, the outer ones cancellate; aperture long, wider beneath. In section D. we may notice V. episcopalis; shell emarginate, smooth; margins of the whorls entire; lip denticulate; pillar with four plaits. It inhabits India. The inhabitant, or fish, is said to be of a poisonous nature, if eaten, and to wound those who touch it with a kind of pointed trunk. The natives of the island of Tanna fix the shells in handles and use them as hatchets.

VOLUTE, in architecture, a kind of spiral scroll, used in the Ionic and Composite capital, whereof it makes the principal characteristic and ornament.

VORTICELLA, in natural history, a genus of Vermes Infusoria class and order. Body contractile, naked, and furnished with ciliate rotatory organs. There are about fifty or sixty species in sections. A. Seated on a pedicle, or stem. B. Furnished with a tail. C. Without a tail. V. anastatica is compound, bell-shaped, with an oblique mouth and scaly rigid stem.

It inhabits fresh waters, forming clusters branched out in various directions; ovaries seated on the stems in the form of bulbs, which detach themselves from the stems, and fix themselves to other substances, producing a new cluster. V. nasuta is cylindrical, with a projecting point in the middle of the cup. It is found in stagnant water, invisible to the naked eye, pellucid, changing its form perpetually, quick in motion, and having a rotatory organ surrounding the middle of the body.

VOSSIUS (GERARD JOHN,) in biography, one of the most learned and laborious writers of the seventeenth century, was of a considerable family in the Netherlands, and was born in 1577, near Heidelberg, at a place where his father, John Vossius, was minister. He first learned Latin, Greek, and Philosophy, at Dort, where his father had settled, and died. In 1595, he went to Leyden, where he further pursued these studies, joining mathematics to them, in which science he made a considerable progress. He became Master of Arts and Doctor in Philosophy, in 1598; and soon after Director of the College at Dort; and, in 1618, Professor of Eloquence and Chronology in the academy there, the same year in which appeared his "History of the Pelagian Controversy." This history procured him much odium and disgrace on the Continent, but an ample reward in England, where Archbishop Laud obtained leave of King Charles I. for Vossius to hold a prebendary in the church of Canterbury, while he resided at Leyden. This was in 1629, when he came over to be installed, took a Doctor of Laws degree at Oxford, and then returned.

In 1633, he was called to Amsterdam to fill the chair of a Professor of History; where he died in 1649, at seventy-two years of age: after having written and published as many works as, when they came to be collected and printed at Amsterdam in 1695, &c., made six volumes folio.

VOTES. The decision of any question by an assembly of persons, being in its own nature impracticable in the case of dissent by one or more of the individuals, it becomes an object of practical necessity to provide for that case, in most instances, by some expedient. In our English law, the determination of twelve men upon a jury is rendered unanimous by annexing the condition, that they shall not delay longer than it shall be possible for them to subsist without the necessaries of life. Upon almost any other occasion it has been established, that the wish of the majority shall be taken as the sense of the whole.

This last rule is, however, capable of many modifications, one of the most striking is that which is used in all arrangements of delegation. In order to insure the possession of knowledge, fidelity, diligence and dispatch, it is usual in society to perform the business of the public by delegates, in successive order of power and responsibility. Thus, a large and mixed multitude, possessing very little political knowledge, liable for the most part to be misled by prejudices or corruption, incapable, on many accounts, of pursuing objects with steadiness, and from their number absolutely unable to deliberate or decide, with the smallest degree of efficacy, may nevertheless be very capable of determining the single question, who shall be their delegate in a less numerous assembly of wise and virtuous men; and this last assembly may give power to their chairman and their committees to perform many acts which could scarcely be effected by themselves in their entire mass.

These proceedings, however, are supposed to have the determination of single questions in view at a time; but there are questions of vote which in their own nature possess a degree of complexity. Into these our limits will not allow us to enter, but there is one relating to personal elections, which Borda, in his Memoirs of the French Academy, has pointed out, and is entitled to our notice. It relates to the choice of one out of a number of candidates, which is made simply by taking him who has the majority of voices, but which may not coincide with the wish of the electors, and may even be that which is the most opposite to that wish.

The example is, suppose these candidates, A, B, and C, had twenty-one electors; then if A have eight votes, B seven, and C six, A will be elected. But the truth here manifested is, that eight voters out of twenty-one give the preference to A beyond B and C, and it is not known in what order of preference those voters place these two last. A like observation may be made as to the other sets who have voted in preference for B and C. So that if the seven voters for B had possessed the means of showing, and had declared their preference of C to A, C would have had thirteen votes, and prevailed against A; and there is nothing

in this cause of election which can show that this would not have been the result.

Mr. B. proposes that this should be remedied by each voter giving in a list of the order of merit in the candidates, and he shows at length, by mathematical reasoning, the true indication to be deduced from such lists. But as this practice might probably be too remote from vulgar apprehension to be much approved, it may be sufficient to refer the reader to the Memoir, and to remark that, in order to be certain that an election, made in the common way, is really the wish of the majority, it is necessary that the number of votes obtained by the successful candidate should be to the whole number of electors, in a greater ratio than the number of candidates by one to their total number.

VOWEL, in grammar, a letter which affords a complete sound of itself, or a letter so simple as only to need a bare opening of the mouth to make it heard, and to form a distinct voice. See GRAMMAR.

The vowels are six in number, *viz.* A, E, I, O, U, Y, and are called vowels in contradistinction to certain other letters, which depending on a particular application of some part of the mouth, as the teeth, lips, or palate, can make no perfect sound without an opening of the mouth, that is, without the addition of a vowel, and are therefore called consonants.

UPRIGHT, in heraldry, is used in respect of shell fishes, as crevices, &c. when standing erect in a coat.

UPUPA, the *hoopoe*, in natural history, a genus of birds of the order Picæ. Generic character: bill long, slender, and bending; nostrils in the base of the bill; tongue obtuse, entire, and triangular; middle toe of the three toes before connected in some degree to the outermost. There are eight species, of which the following deserve the chief notice. U. epops, common hoopoe of Europe; this weighs three ounces, and is a foot long; is found in Europe, Asia, and Africa; but, even in the warmest countries of Europe, is said to be migratory. In England it is by no means abundant. It is devoted to solitude, and rarely seen even in pairs. At Cairo, however, in Egypt, these birds appear in small flocks, and build on the terraces of houses fronting the bustle and noises of the street. They seldom perch on trees, confining themselves almost entirely to the ground. When agitated by strong passion, whether of surprise or anger, of fear or attachment, they erect their crests and spread their tails with great fullness and intensity. They feed upon insects, and give them to their young; and their nests are, for the want of that cleanly management for which birds are generally distinguished, intolerably disgusting to the smell, in consequence of the putrid remains of this species of food. In confinement they will live on bread and cheese, or raw meat. See Aves, Plate XIV. fig. 4.

U. promerops is about four feet long, but the body is little larger than that of a pigeon. Its plumage is of the most various, beautiful, and brilliant colour, and strongly reminds the observer of the bird of paradise, to which, indeed, it is considered as allied. It is found in New Guinea, and employed by the natives as one of the most striking personal embellishments.

URAN, in mineralogy, a genus of ores containing three species. 1. "Pitch ore," of a velvet black colour, inclining to iron-black; it occurs almost always massive and disseminated: specific gravity between 6.3 and 7.5. It is completely infusible, without addition, before the blowpipe. With soda, or borax, it forms a grey, slaggy globule; with phosphoric salts a transparent green bead. It dissolves imperfectly in sulphuric and muriatic acids; but is nearly dissolved in nitrous and nitro-muriatic acids. It consists of

Uran	86.5
Oxide of iron	2.5
Sulphurated lead	6.0
Silica	5.0
	100.0

It occurs in veins, in primitive mountains, with lead and silver ores; and is usually accompanied with lead glance, copper pyrites, iron ochre, &c. It is found in Saxony and Norway, and is distinguished from brown-blende by colour, specific gravity, fracture, and streak; from wolfram by its streak and fracture.

The chief colour of the second species, uran-mica, is grass-green: specific gravity 3.1. It dissolves in nitrous acid without effervescence, and communicates to it a lemon-yellow colour. It consists of an oxide of uran, with a slight admixture of copper. It occurs in ironstone veins, in Cornwall, Germany, and

France. It is not like mica, to which it has a great resemblance, elastic.

The third species is uran-ochre, which is of a straw-yellow colour: it occurs usually as a coating or efflorescence on pitch ore. From the ore we have

URANIUM, in chemistry, a metal discovered by Klaproth in the year 1789. It was then announced as a metal more difficult to be reduced than manganese, externally of a grey colour, and internally of a clear brown, of considerable lustre, and middling hardness, that it might be scratched and filed, and that its oxide gives a deep orange colour to porcelain. It has been obtained from three different minerals. The first is in the state of sulphuret, of a blackish colour, and of a shining fracture, and sometimes lamellated. In this state it is sometimes combined with iron and sulphurated lead. The uranium is in the metallic state.

The second ore from which this metal is obtained, is the native oxide of uranium. It is always in the state of yellow powder, on the surface of the sulphuret. The specific gravity is 3.24. When it is of a pure yellow colour it is then a pure oxide.

The third ore of the metal is the native carbonate of uranium. Of this there are two distinct varieties, the one of a pale green, and sometimes of a silvery white colour. This contains but a small quantity of the oxide of copper, and is very rare. The other is of a shining deep green, which is the green mica, or glimmer, of mineralogists. Klaproth supposed that it contained an oxide of uranium, mixed with the oxide of copper; but it has been since discovered to have carbonic acid in its composition. It is crystallized in small square plates, and sometimes, though rarely, in complete octahedrons.

The process by which Klaproth reduced this metal is the following: he mixed the yellow oxide of uranium, precipitated from its solutions by an alkali, with linseed oil, in the form of a paste, and this being exposed to a strong heat, there remained a black powder, which had lost rather more than one-fourth of its weight. It was then exposed to the heat of a porcelain furnace, in a close crucible, and the oxide was afterwards found in a coherent mass, but friable under the fingers, and reduced to a black shining powder. It decomposed nitric acid with effervescence. This black powder, covered with calcined borax, was for the second time exposed to a still stronger heat, by which metallic mass was obtained, consisting of very small globules adhering together.

The colour of uranium is of a dark grey, and internally of a pale brown. It has little brilliancy, on account of the spongy mass, in which state it is obtained. It may be scratched with a knife, and is extremely infusible. The specific gravity is 6 4. When uranium is exposed to a red heat in the open air, or when it is acted on by the blow-pipe, it undergoes no change. The yellow oxide of uranium does not melt. It acquires a brownish-grey colour when it is long heated in the air, but it has not been ascertained whether it gains or loses oxygen. The oxide of uranium is reduced by means of charcoal, when it is exposed to heat. The yellow oxide, when mixed with common enamelling flux, tinges porcelain of a deep orange colour.

URANIA, in botany, a genus of the Hexandria Monogynia class and order. Natural order of Musæ, Jussieu. Essential character: calyx none; corolla three-petalled; nectary two-leaved, with one of the leaves bifid; capsule inferior, three-celled, many-seeded; seeds in two rows, covered with an aril. There is only one species, *viz.* U. speciosa, a lofty tree, growing naturally in the marshy places of Madagascar

URANOSCOPUS, the *star-gazer*, in natural history, a genus of fishes of the order Jugulares. Generic character: head large, depressed, rough; mouth with an internal cirrus; gill-membrane with six papillous-toothed rays; gill-covers edged with a membranaceous fringe.

U. scaber, or the bearded star-gazer, is a native of the Mediterranean, and frequents deep places near the shores, feeding on aquatic insects and small fishes, which it decoys within its reach by waving the long cirrus of the mouth in various directions. The smaller fishes mistake these for worms, and in endeavouring to seize the supposed food are themselves caught, and devoured by the star-gazer, which lays imbedded and unobserved in the mud or gravel of the bottom.

URENA, in botany, a genus of the Monadelphia Polyandria class and order. Natural order of Columniferæ. Malvaceæ, Jussieu. Essential character: calyx double, outer five-cleft; capsule five-cleft, divisible into five parts, with the cells closed, and one seed in each. There are eight species.

URETHRA. See ANATOMY.

UREA, in chemistry. The nature and properties of urea have been chiefly investigated by Fourcroy and Vauquelin. It is obtained from urine. It may be extracted by the following process: If a quantity of human urine, which has been passed a few hours after taking food, be evaporated with a gentle heat, to the consistence of a thick syrup, and allowed to cool, it concretes into a crystalline mass. Add to this mass, in separate portions, four times its weight of alcohol; with the application of a gentle heat, great part is dissolved, and what remains consists of different saline substances. Separate the solution from the undissolved part, and introduce it into a retort. Distil with the heat of a sand bath, and continue the boiling till the liquid is reduced to the form of a thick syrup. The matter which remains in the retort crystallizes as it cools. The crystals thus formed are urea.

Urea, which is prepared by this process, is crystallized in the form of plates, crossing each other. It is viscid, resembling thick honey, and of a yellowish white colour. It has a strong acrid taste, and a fetid alliaceous smell. It deliquesces in the air, and by attracting moisture is converted into a thick brown liquid. It is very soluble in water, and also in alcohol. The solution in water concentrated is of a brown colour. This solution is gradually decomposed, air is emitted, which is partly composed of ammonia, and acetic acid is formed in the liquid. If the solution in water be boiled, and as the evaporation goes on fresh portions of water be added, the urea is decomposed; carbonate of ammonia is disengaged, while acetic acid is formed, and charcoal precipitated. The component parts of urea, therefore, are supposed to be

Oxygen	39.5
Azote	32.5
Carbon	14.7
Hydrogen	13.3
	100.0

The caustic fixed alkalies readily dissolve urea, and disengage from it ammonia; and the solution contains the benzoic, acetous, and carbonic acids, united with the alkali employed. The urea almost entirely disappears from urine during certain diseases, and a very large quantity of saccharine matter is produced, which, when evaporated and clarified, resembles Muscovado sugar.

URIC *acid* This acid was discovered by Scheele in the year 1776. It was at first called lithic acid. It constitutes one of the component parts of urinary calculi, and is also found in human urine. There is one species of calculus which is almost entirely composed of this substance; it is that species which resembles wood in appearance and colour. This acid is insipid, inodorous, almost insoluble in cold water, and soluble only in about 360 parts of boiling water. It separates from this when it cools, into small yellowish crystals. The solution in water reddens the tincture of turnsole. There is scarcely any action between the uric acid and the sulphuric and muriatic acids. It is soluble in the concentrated nitric acid, to which it communicates a red colour. It would appear that in this change of colour the nature of the acid is also changed, for part of it is converted into oxalic acid. Oxymuriatic acid very readily acts upon uric acid, either by suspending a calculus in the liquid acid, or, which is easier, by passing a stream of oxymuriatic acid gas through water, at the bottom of which is placed the uric acid in powder. Its colour becomes pale, the surface swells up, it softens, and is at last converted into a jelly. This part disappears, and is soon dissolved, giving a milky colour to the liquid. There is extricated, by slow efferverscence, small bubbles of carbonic acid gas. The liquid by evaporation gives muriate of ammonia, acidulous oxalate of ammonia, both crystallized, muriatic acid, and malic acid. Thus the oxymuriatic acid decomposes the uric acid, and converts it into ammonia, carbonic, oxalic, and malic acids. Various facts show that uric acid is a compound of a very peculiar kind, formed of azote, of carbon, of hydrogen, and oxygen, and susceptible of a great number of different changes by chemical agents.

URINE. The properties of urine vary considerably, according to the constitution and health of the body, and the period when it is voided after taking food. The urine of a healthy person is of a light orange colour, and uniformly transparent. It has a slightly aromatic odour, in some degree resembling that of violets. It has a slightly acrid, saline, bitter taste. The specific gravity varies from 1.005 to 1.033. The aromatic odour, which leaves it as it cools, is succeeded by what is called the urinous smell, which latter is converted to another, and, finally, to an alkaline

odour. Urine converts the tincture of turnsole into a green colour, from which it is concluded that it contains an acid. No less than thirty different substances have been detected in urine by chemical analysis; *viz.* a great variety of salts, acids, ammonia, &c.

Urine is much disposed to spontaneous decomposition. The time when this process commences, and the rapidity of the changes which take place, depend on the quantity of the gelatine and albumen. When the proportion of these substances is considerable, the decomposition is very rapid. This is owing to the great number of substances, and the united force of their attractions overcoming the existing affinities of the different compounds of which fresh urine consists, and especially to the facility with which urea is decomposed. This substance is converted during putrefaction into ammonia, carbonic acid, and acetic acid. Hence the smell of ammonia is always recognized while urine is undergoing these changes. Part of the gelatine is deposited in a flaky form, mixed with mucilage. Ammonia combines with phosphoric acid, and the phosphate of lime is precipitated. It combines also with phosphate of magnesia, and forms a triple salt. The other acids, the uric, benzoic, the acetic, and carbonic acids, are all saturated with ammonia. See PHYSIOLOGY.

URSUS, the *bear*, in natural history, a genus of Mammalia, of the order Feræ. Generic character; six front teeth both above and below, the two lateral ones of the lower jaw lobed, and longer than the others, with smaller or secondary teeth at the internal bases; tusks solitary; five or six grinders on each side, the first approaching the tusks; tongue smooth; snout prominent; eyes furnished with a nictitating membrane. There are ten species.

U. arctos, the brown bear, is met with in almost all the northern territories of Europe and Asia, and lives solitary in remote forests, subsisting principally on fruits and other vegetable substances, and occasionally devouring animals. It is particularly fond of honey, and is said to possess great sagacity in discovering it; and will ascend high trees to obtain it. It frequently resides in the hollows of trees, and sometimes fixes its habitation in the banks of rivers, for the sake of fish, which it sometimes takes and devours. Towards the close of autumn, it retires to its habitation in a state highly fleshy and fat, and remains for weeks together without food, and almost without motion. The female withdraws to the most obscure recesses at the same time, to produce her young, which are in general no more than two, extremely small, and in form little resembling the future full-grown animal. During the first month these are blind; for four months they are attended by the dam with such vigilance and tenderness, that she almost abstains from her own necessary nourishment. After a certain period, the female returns to the den of the male with her young, which it was necessary for a time to secrete from him, lest he should devour them; and in spring they quit their cavern, and range with great voracity, after their long confinement, in pursuit of food. They will climb trees with great alacrity, and strip them almost completely of their fruit. The date tree is a particular favourite with them. These animals are often taken young, and subdued to a great degree of tameness and docility, and taught a variety of tricks and dances: but the discipline of torture is applied to produce these effects; and the extreme cruelty requisite to accomplish these creatures for the usual exhibitions they are instructed to make, are a disgrace to civilized society, and worthy of the interference of legislation. Bears were formerly common in Greece; and even in this country they once existed, and were guarded with jealousy by the forest laws, as beasts of chace; and after their extermination they were imported for the diversion of baiting them, which was an entertainment displayed in honour of nobles and princes. They were exhibited, from Africa, in the grand spectacles at Rome. See Mammalia, Plate XXI. fig. 4.

U. Americanus, or the American bear, has a long pointed nose, and is generally smaller than the above species. It abounds in the northern territories of America, and is said to live exclusively on vegetable food, extreme hunger only being able to induce it to eat the flesh of animals. These bears reside in trees, mounting and descending them with great alertness. Their skins form an important article of merchandize; their flesh, when young, is thought delicious; and their fat is thought an admirable application for sprains and bruises. They are taken frequently by setting fire to the trees which they inhabit.

U. maritimus, or the Polar bear, is nearly double the size of the common bear, and is stated to have been seen of the

length of twelve feet. It is completely white. Its principal residence is on the shores of Greenland and Hudson's Bay, and it inhabits only the coldest regions of the world. It possesses the most formidable strength and ferocity. The sailors of Barentz, in his voyage in quest of a north-east passage to China, were assaulted in their boat by these animals, carried off, and devoured within the view of their companions. They will attempt to board armed ships, and, defying every obstacle with the most fearless energy, have sometimes only with the greatest difficulty been prevented. They subsist on fishes, seals, and whales, at sea; and by land devour birds, hares, deer, and various other animals; and will also eat berries and various other vegetables. In Greenland they sometimes surround the habitations of the natives, allured by the strong smell of the seal oil, and attempt to break through to commit their depredations; but are reported to be effectually repelled by the smell of burnt feathers. In winter they ingulph themselves in the snow, or immure themselves in some cavern, where they pass in torpor the Polar night, making their egress only with the re-appearance of the sun: in summer they are often found on large masses of floating ice at sea, and, swimming with great excellence, they pass from one of these to another with much facility; they are sometimes, however, carried to vast distances from land, and perish for want of the means of subsistence. They produce generally two young ones at a birth, and the attachment between these and the dam is one of the strongest exhibited in the whole animal creation. The natives of Kamtschatka always avoid firing at a young bear if the dam be present, as the rage of the latter to revenge the injury is active and unbounded, and she rushes to the spot from which the attack was made with almost irresistible rapidity and fury: she, moreover, deplores the destruction of her cubs by sounds and gesticulation, indicating the most violent and heart-rending sorrow, folding them, though lifeless, to her bosom, attempting to recover them back to animation, and continuing by them long after the last spark of life has been extinguished in them. The fondness of the young for the parent is little less strong and impressive. These creatures are hunted by the natives of Kamtschatka with great skill, intrepidity, and success: if the bear should not instantly fall by a musket-shot, or be disabled from running, he rushes towards his antagonist, animated with the completest spirit of vengeance; and, should he not, in this instant, be received upon the spear, which is dexterously prepared to transfix him at the critical moment, the death of the hunter is almost the certain and immediate consequence. Fatal results have not unfrequently attended the sportsmen in these conflicts. These animals have considerable sagacity, and are stated, upon respectable authority, to ascend rocks with extreme caution, to avoid the observance of a herd of bareins, feeding beneath, and which, on account of the speed of the latter, they could not openly approach: from these summits, however, they will loosen and roll down large stones, and thus destroy or mutilate their prey beneath, descending afterwards to enjoy the rich reward of their stratagem and toil. The inhabitants of Kamtschatka are reported to pride themselves in imitating the movements of the bears in their dances, and to acknowledge themselves highly indebted to them for the application of various simples for wounds and diseases. The morse is one of the most formidable enemies of the bear, and generally triumphs from the advantage of its lengthened and formidable tusks. See Mammalia, Plate XXI. fig. 5.

The U. gulo, or glutton, is about three feet long, exclusively of its tail, which is one foot in length. It is met with in the northern regions of America, Europe, and Asia. Its name is characteristically derived from its habits, as it preys with extreme voracity on almost every species of animal food, in its fresh or putrid state. It is said to lay wait in trees, and to spring on a variety of animals passing unsuspectingly beneath, and, after exhausting them, by sucking their blood, to tear them in pieces and devour them. It produces from two to four young once a year. Its strength and ferocity are such, that it sometimes contends for its prey, victoriously, even with the wolf or the bear. The skin of this animal is an article of commerce, and it is most esteemed as such in proportion as its colour approaches to a perfect blackness.

U. luscus, or the wolverene, is supposed to be merely a variety of the former. It has been brought into this country from Hudson's Bay, about twice the size of a fox, and was, in this instance, perfectly tame and inoffensive.

U. lotor, or the raccoon, is a native of America and the West Indies, of a grey colour, and with a head shaped like that of a fox, and of the length of between

two and three feet without the tail. Its natural food consists of fruits, young sugar-canes, and unripe maize; and also, it is thought, of eggs and poultry. It is nocturnal, and seldom quits its hole by day; and during the rigours of winter, it continues there in a state of abstinence and perhaps of torpor. It may be domesticated with great facility, and is seen in this familiar state in many houses in America. It is agile and sprightly, ascends trees with great ease, is particularly fond of vegetable sweets, and averse from acid substances, and, while taking its food, generally uses its fore feet as hands, sitting on its hind ones. It is said to have an admirable tact at opening oysters and other shells, and is extremely cleanly in all its habits. Its fur is highly useful in the manufacture of hats.

U. meles, or the common badger of Europe, is about two feet from the nose to the tail, and is found in almost all the temperate regions both of Europe and Asia, living in subterranean habitations, which its feet are admirably adapted for preparing. Its food consists of fruits and roots, frogs and insects; and the resemblance of its teeth to those of beasts of prey, makes it probable that it destroys lambs and larger animals, which it is stated to do; in a domestic state it prefers raw flesh to every other species of food. It will attack bee-hives, to obtain the honey contained in them. It sleeps much; passes the winter, or the greater part of it, in its burrowed residence, in a state of lethargy and torpor; and in summer produces, generally, three young ones at a birth. These animals are inoffensive in their manners; reluctant to attack, but well prepared by nature for defence, which they conduct with an alertness, intrepidity, and perseverance, truly admirable. To afford a spectacle of these qualities to the populace of several countries, the badger is frequently baited with dogs, which, from the looseness of the badger's skin and the coarseness of its hair, are prevented sometimes from penetrating to his flesh with their teeth, and almost always, from so fastening him by their bite as to preclude his turning in various directions for their annoyance. The strength of his jaws, and the sharpness of his teeth, enable him to deal the most painful and destructive wounds; indeed, his bite almost uniformly brings with it the flesh, as well as the blood of his antagonist. He is at length overpowered by numbers, but seldom without having inflicted a severe and fatal revenge. His agility of movement in the conflict gives a most important advantage, as his blow is, as it were, struck while the enemy is only preparing for the attack. The badger is particularly cleanly in his habits; and his flesh, prepared like that of the hog, is said to be equally valuable and well-flavoured.

U. horribilis (of Mr. G. Ord) the Grizly Bear. This animal, says Mr. Brackenridge, is the monarch of the country which he inhabits. The African lion, or the tiger of Bengal, are not more fierce or terrible. He is the enemy of man, and literally thirsts for his blood. So far from shunning, he seldom fails to attack; and even to hunt him. The colour is usually such as the name indicates, though there are varieties, from black to silvery whiteness. He is not seen lower than the Mandan villages. In the vicinity of Roche Jaune, and of Little Missouri, they are said to be most numerous. They do not wander much in the prairies, but are usually found in points of wood, in the neighbourhood of large streams.

URTICA, in botany, *nettle*, a genus of the Monoecia Tetrandria clas and order. Natural order of Scabridæ. Urticæ, Jussieu. Essential character: male, calyx four-leaved; corolla none; nectary central, cup-shaped: female, calyx two-leaved; corolla none; seed one, superior, shining. There are fifty-nine species.

URTICULARIA, in botany, *bladderwort*, a genus of the Diandria Monogynia class and order. Natural order of Corydales. Lysimachiæ, Jussieu. Essential character: corolla ringent, spurred; calyx two leaved, equal; capsule one-celled. There are thirteen species.

USANCE, in commerce, is a determinate time fixed for the payment of bills of exchange, reckoned either from the day of the bills being accepted, or from the day of their date; and thus called, because regulated by the usage and custom of the places whereon they are drawn. See EXCHANGE.

USE, in law, is a trust and confidence reposed in another, who is tenant of the land, that he shall dispose of the land, according to the intention of *cestuy que use*, or him to whose use it was granted, and suffer him to take the profits.

By statute 27, Henry VIII. c. 10. commonly called the statute of uses, or the statute for transferring uses into possession, the *cestuy que use* is considered as the real owner of the estate; whereby it is enacted, that when any person is seised of lands to the use of another, the person

entitled to the use in fee-simple, fee-tail, for life or years, or otherwise, shall stand and be seised or possessed of the land, in the like estate as he hath of the use, trust, or confidence. And thereby the act makes *cestuy que use* complete owner both at law and in equity. This is one of the most important statutes in the law respecting conveyances, and it is as it were the hinge, upon which all the system of conveyancing turns. It is extremely difficult to explain its effect in this dictionary, but it may be important to say, that in any conveyance which operates under the statute of uses, it is necessary to declare a use, as to say the estate is given to A B, to the use of A B, without which the use, that is, all the interest in the estate, results to the donor. A trust is now what a use was formerly. See Trust.

USHER, an officer, or servant, who has the care and direction of the door of a court, hall, chamber, or the like.

In the king's houshold there are two gentlemen ushers of the privy-chamber appointed to attend the door, and give entrance to persons that have admittance thither; four gentlemen-ushers, waiters; and eight gentlemen-ushers, quarter-waiters in ordinary.

Usher also signifies an officer of the Court of Exchequer, of which there are four, who attend the barons and chief officers of that court at Westminster, as also juries, sheriffs, &c. at the pleasure of the court. There is also an usher of the Court of Chancery.

USHER *of the Black Rod*, the eldest of the gentlemen-ushers daily waiters at court, whose duty is to bear the rod before the King at the feast of St. George, and other solemnities: he has also the keeping of the chapter-house door, when a chapter of the order of the garter is sitting, and in time of parliament attends the house of peers, and takes delinquents into custody. He wears a gold badge, embellished with the ensigns of the order of the garter.

USTERIA, in botany, a genus of the Monandria Monogynia class and order. Essential character: calyx fonr-toothed, with one segment much larger than the rest; corolla funnel-form, four-toothed; capsule one-celled, two-seeded; seeds arilled. There is but one species, *viz.* U. guineensis, a native of Guinea.

USURY, in a strict sense, is a contract upon the loan of money, to give the lender a certain profit for the use of it, upon all events, whether the borrower made any advantage of it, or the lender suffered any prejudice for the want of it, or whether it be repaid at the appointed time or not; and in a large sense, it seems, that all undue advantages, taken by a lender against a borrower, come under the notion of usury.

The statute 12 Anne, c. 16, enacts that no person, upon any contract which shall be made, shall take for loan of any money, wares, &c. above the value of 5*l.* for the forbearance of 100*l.* for a year; and all bonds and assurances for the payment of any money to be lent upon usury, whereupon or whereby there shall be reserved, or taken, above five pounds in the hundred, shall be void; and every person who shall receive, by means of any corrupt bargain, loan, exchange, shift, or interest, of any wares, or other things, or by any deceitful way, for forbearing, or giving day of payment for one year, for their money or other things, above 5*l.* for 100*l.* for a year, &c. shall forfeit treble the value of the monies or other things lent.

But if a contract, which carries interest, be made in a foreign country, our courts will direct the payment of interest, according to the law of that country in which the contract was made. Thus, Irish, American, Turkish, and Indian interest have been allowed in our courts, to the amount of each 12*l.* per cent. For the moderation or exorbitance of interest depends upon local circumstances; and the refusal to enforce such contracts would put a stop to all foreign trade.

It may be considered as a general rule, that whatever is taken for interest can by no trick or contrivance be so concealed as to evade the general words of this statute. It is a question in politics, whether the laws against usury are good for any thing, except to afford government a monopoly in the borrowing of loans. Where advantage is taken of ignorance or distress, equity would relieve in all cases. But surely it is hard to prevent men from making the fair price of the loan of money. A maximum is always injurious. The real price of interest is not well settled, and usurers are compelled to be exorbitant to indemnify themselves of extraordinary risks.

UVARIA, in botany, a genus of the Polyandria Polygynia class and order. Natural order of Coadunatæ. Anonæ, Jussieu. Essential character: calyx three-leaved; petals six; berries numerous, pendulous, four-seeded. There are eleven species.

VULGATE, a very ancient Latin trans-

lation of the bible, and the only one the church of Rome acknowledges authentic. See BIBLE. The ancient vulgate of the Old Testament was translated almost word for word from the Greek of the LXX. The author of the version is not known, nor so much as guessed at.

VULGATE *of the New Testament.* This the Romanists generally hold preferable to the common Greek text, in regard it is this alone, and not the Greek text, that the council of Trent had declared authentic. Accordingly that church has, as it were, adopted this addition. The priests read no other at the altar, the preachers quote no other in the pulpit, nor the divines in the schools.

VULTURE, the *vulture,* in natural history, a genus of birds of the order Accipitres. Generic character: the bill strait, hooked at the point; the head without feathers; the skin on the fore part naked; tongue bifid; neck retractile; legs and feet covered with great scales; claws large, little hooked, and very blunt. These birds are repacious to an extreme degree, and sometimes feed in the midst of cities unterrified. It is observed that they prefer, universally, tainted meat to what is fresh, and seldom destroy animals when they can procure a sufficiency of carrion. Their scent is in the highest degree acute, and they are supposed to perceive the effluvia of carcases at the distance even of miles. They are found most numerous in the warmest climates, and must be regarded as a race of birds eminently useful in clearing the surface of the globe from putrid remains, which might infect the air, and produce all the ravages and mortality of pestilence. There are seventeen species, of which we shall notice the following.

V. gryphus, or the condur vulture, is found particularly in South America, and from point to point of its wings is of the width of twelve feet. The feathers of its back are of a brilliant black. Its quill feathers are more than two feet and a quarter in length, and are half an inch in diameter.

V. harpyia, or the crested vulture, is rather larger than a turkey, and is ditinguished by a crest of four feathers on its head. Its strength is extraordinary, and with a single stroke of its bill it is reported to be able to cleave down the scull of a man. It is found in Mexico and Brasil.

V. aura, or the carrion vulture, is of the same size as the last, is common both in North and South America, and feeds on carcases and on snakes. Its odour is particularly rank. It is far from being ferocious and dangerous, may be easily reared tame, and is considered in the West Indies as highly useful in destroying reptiles, vermin, and carrion, insomuch that the killing of them is prohibited by law. They roost together at nights in considerable numbers, in the manner of rooks.

V. sagittarius, or the secretary vulture, is distinguished by the extraordinary length of its legs, and, when standing upright, is a yard high. It is found in Africa, and in the Philippine Islands. It principally lives on lizards and rats, and various species of vermin. It strikes with its feet forwards, and never the contrary. It takes up tortoises in its claws, and dashes them with great force on the ground, and will repeat this process till these animals are completely killed. For the king vulture, see Aves, Plate XIV. fig. 5.

UVULARIA, in botany, a genus of the Hexandria Monogynia class and order. Natural order of Sarmentaceæ. Lilia, Jussieu. Essential character: corolla six-petalled, erect; nectary hollow at the base of each petal; filaments very short. There are six species.

W.

W, or w, is the twenty-first letter of our alphabet, and is composed, as its name implies, of two v's. It was not in use among the Hebrews, Greeks, or Romans, but chiefly peculiar to the northern nations, the Teutones, Saxons, Britons, &c. But still it is not used by the French, Italians, Spaniards, or Por-

tuguese, except in proper names, and other terms borrowed from languages in which it is originally used, and even then it is sounded like the single v. This letter is of an ambiguous nature, being a consonant at the beginning of words, and a vowel at the end. It may stand before all the vowels except *u*, as *water*, *wedge*, *winter*, *wonder*: it may also follow the vowels, *a*, *e*, *o*, and unites with them into a kind of double vowel, or diphthong, as in *saw*, *few*, *cow*, &c.

WACCE, in mineralogy, a species of the clay genus, of a greenish grey colour, of various degrees of intensity; it occurs sometimes massive, sometimes vesicular, and the vesiculæ are either filled when the compound is denominated amygdaloid, or empty. It is not very heavy, and it is the characteristic of it that it falls to pieces in the open air. It belongs to the floetz trap formation; where it occurs in beds which generally lie under basalt, and above clay. It is found in veins, and generally forms the basis of amygdaloid. It frequently contains imbedded crystals of mica and basaltic hornblende, but does not, like basalt, include augite or olivine. It is found in many parts of Germany, and in Sweden, Werner considers it as intermediate between basalt and clay. When basalt contains mica, it is passing to wacce. Near Joachimstal there is an immense rent filled with wacce, in which whole trees are found imbedded.

WACHENDORFIA, in botany, a genus of the Triandria Monogynia class and order. Natural order of Ensatæ. Irides, Jussieu. Essential character: corolla six-petalled, unequal, inferior; capsule three-celled, superior. There are five species, all natives of the Cape of Good Hope.

WADD, or WADDING, is a stopple of paper, hay, straw, or the like, forced into a gun upon the powder, to keep it close in the chamber; or to put up close to the shot, to keep it from rolling out.

WAFERS are made thus: take very fine flour, mix it with glair of eggs, isinglass, and a little yeast; mingle the materials; beat them well together, spread the batter, being made thin with gum water, on even tin plates, and dry them in a stove; then cut them out for use. You may make them of what colour you please, by tinging the paste with brazil or vermillion for red; indigo or verditer, &c. for blue; saffron, turmeric, or gamboge, &c. for yellow.

WAFT, in naval language, a signal displayed from the stern of a ship for some particular purpose, by hoisting the ensign, furled up together into a long roll, to the head of its staff, or to the mizen-peek. It is particularly used to summon the ship's boats off from the shore.

WAGER of law is a particular mode of proceeding, whereby, in an action of debt, brought upon a simple contract between the parties, without any deed or record, the defendant may discharge himself by swearing in court, in the presence of compurgators, that he owes the plaintiff nothing, in manner and form as he has declared, and his compurgators swear, that they believe what he says is true. And this waging his law is sometimes called making his law. It being at length considered, that this waging of law offered too great a temptation to perjury, by degrees new remedies were devised, and new forms of action introduced, wherein no defendant is at liberty to wage his law, as in assumpsit and trover. Also when a new statute inflicts a penalty, and gives an action of debt to recover it, it is usual to add, in which no wager of law shall be allowed.

WAGERS. In general a wager may be considered as legal, if it be not an incitement to a breach of the peace, or to immorality, or if it do not affect the feelings or interest of a third person, or expose him to ridicule; or if it be not against sound policy. See INSURANCE, WAGER, POLICY.

WAIFS, are goods which are stolen and waved by a felon in his flight from those who pursue him, which are forfeited; and though waif is generally spoken of goods stolen, yet if a man be pursued with hue and cry as a felon, and he flee and leave his own goods, these will be forfeited as goods stolen; but they are properly fugitive's goods, and not forfeited till it be found before the coroner, or otherwise of record, that he fled for the felony. See ESTRAYS.

WAIST, in ship-building, that part of a ship which is contained between the quarter-deck and forecastle, being usually a hollow space, with an ascent of several steps to either of those places. When the waist of a merchant ship is only one or two steps of descent from the quarter-deck and forecastle, she is said to be galley built; but when with six or seven steps, she is called frigate-built.

WAISTERS, in naval affairs, people stationed in the waist in working the

ship. As their business requires only strength without art or judgment, they are commonly selected from the strongest landsmen and ordinary seamen.

WAIVER, signifies the passing by of a thing, or a refusal to accept it: sometimes it is applied to an estate, or something conveyed to a man, and sometimes to plea, &c. and a waiver on disagreement as to goods and chattels, in case of a gift, will be effectual.

WAKE *of a ship*, is the smooth water astern when she is under sail. This shows the way she has gone in the sea, whereby the mariners judge what way she makes. For if the wake be right a-stern, they conclude she makes her way forwards; but if the wake be to leeward a point or two, then they conclude she falls to the leeward of her course. When one ship, giving chase to another, is got as far into the wind as she, and sails directly after her, they say, she has got into her wake. A ship is said to stay to the weather of her wake, when, in her staying, she is so quick, that she does not fall to leeward upon a tack, but that when she is tacked, her wake is to the leeward; and it is a sign she feels her helm very well, and is quick of steerage.

WALE, or WALES, in a ship, those outermost timbers in a ship's side, on which the sailors set their feet in climbing up. They are reckoned from the water, and are called her first, second, and third wale, or bend.

WALE *knot*, a round knot or knob made with three strands of a rope, so that it cannot slip, by which the tacks, top-sail sheets, and stoppers are made fast, as also some other ropes.

WALE *reared*, on board a ship, a name the seamen give to a ship, which, after she comes to her bearing, is built straight up. This way of building, though it does not look well, nor is, as the seamen term it, ship-shapen, yet it has this advantage, that a ship is thereby more roomy within board, and becomes thereby a wholesome ship at sea, especially if her bearing be well laid out.

WALES. By statute 27 Henry VIII. c. 26, and other subsequent statutes, the dominion of Wales shall be incorporated with, and part of the realm of England; and all persons born in Wales shall enjoy all liberties and privileges as the subjects in England do. And the lands in Wales shall be inheritable after the English tenure, and not after any Welsh laws or customs; and the proceedings in all the law courts shall be in the English tongue. A session is also to be held twice a year in every county, by judges appointed by the King, to be called the Great Sessions of the several counties in Wales, in which all pleas of real and personal actions shall be held, with the same form of process, and in as ample manner, as in the Court of Common Pleas at Westminster; and writs of error shall lie from judgments therein to the Court of King's Bench at Westminster. But the ordinary original writs, or process, of the King's courts at Westminster, do not run into the principality of Wales, though process of execution does, as also all prerogative writs; as, writs of certiorari, quo minus, mandamus, and the like. Murders and felonies in any part of Wales may be tried in the next adjoining English county; the judges of assize having a concurrent jurisdiction throughout all Wales, with the justices of the grand sessions. All local matters arising in Wales, triable in the King's Bench, are, by the common law, to be tried by a jury, returned from the next adjoining county in England. No sheriff or officer in Wales shall, upon any process out of the courts at Westminster, hold any person to special bail, unless the cause of action be twenty pounds, or upwards. 11 and 12 William, c. 9.

WALL, in architecture, the principal part of a building, as serving both to inclose it, and support the roof, floors, &c. See BUILDING.

WALLENIA, in botany, so named in honour of Matthew Wallen, a genus of the Tetrandria Monogynia class and order. Essential character: calyx four-cleft, inferior; corolla tubular, four-cleft; berry one seeded. There is but one species, *viz.* W. laurifolia, a tall tree growing naturally in Jamaica and Hispaniola.

WALLIS (Dr. JOHN), in biography, an eminent English mathematician, was the son of a clergyman, and born at Ashford, in Kent, November 23, 1616. After being instructed, at different schools, in grammar learning, in Latin, Greek, and Hebrew, with the rudiments of logic, music, and the French language, he was placed in Emanuel College, Cambridge. About 1640, he entered into orders, and was chosen Fellow of Queen's College. He kept his fellowship till it was vacated by his marriage, but quitted his college to be chaplain to Sir Richard Darley: after a year spent in this situation, he spent two more as chaplain to Lady Vere. While he lived in this family he cultivated the art of deciphering, which proved very useful to him on several occasions: he

met with rewards and preferment from the government at home for deciphering letters for them; and it is said, that the Elector of Brandenburg sent him a gold chain and medal, for explaining for him some letters written in ciphers.

Academical studies being much interrupted by the civil wars in both the Universities, many learned men from them resorted to London, and formed assemblies there. Wallis belonged to one of these, the members of which met once a week, to discourse on philosophical matters; and this society was the rise and beginning of that which was afterwards incorporated by the name of the Royal Society, of which Wallis was one of the most early members.

The Savilian professor of geometry at Oxford being ejected by the parliamentary visitors, in 1649, Wallis was appointed to succeed him, and he opened his lectures there the same year. In 1653, he published, in Latin, a Grammar of the English Tongue, for the use of foreigners; to which was added, a tract "De Loquela seu Sonorum formatione," &c. in which he considers philosophically the formation of all sounds used in articulate speech, and shows how the organs being put into certain positions, and the breath pushed out from the lungs, the person will thus be made to speak, whether he hear himself or not. Pursuing these reflections, he was led to think it possible, that a deaf person might be taught to speak, by being directed so to apply the organs of speech as the sound of each letter required, which children learn by imitation and frequent attempts, rather than by art.

In 1657, he collected and published his mathematical works, in two parts, entitled "Mathesis Universalis," in quarto; and, in 1658, "Commercium Epistolicum de Questionibus quibusdam Mathematicis nuper habitum," in quarto; which was a collection of letters written by many learned men, as Lord Brounker, Sir Kenelm Digby, Fermat, Schooten, Wallis, and others.

Upon the Restoration he met with great respect; the King thinking favourably of him on account of some services he had done both to himself and his father, Charles I. He was, therefore, confirmed in his places, also admitted one of the King's chaplains in ordinary, and appointed one of the divines empowered to revise the Book of Common Prayer. He was a very useful member of the Royal Society, and kept up a literary correspondence with many learned men.

In 1670, he published his "Mechanica; sive de Motu," quarto. In 1676, he gave an edition of "Archimedis Syracusani Arenarius et Dimensio Circuli;" and, in 1682, he published from the manuscripts, "Claudii Ptolemæi Opus Harmonicum," in Greek, with a Latin version and notes; to which he afterwards added, "Appendix de veterum Harmonica ad hodiernam comparata," &c.

In 1685, he published his "History and Practice of Algebra," in folio; a work that is full of learned and useful matter. Besides the works above mentioned, he published many others, particularly his "Arithmetic of Infinites," a book of genius and good invention, and perhaps almost his only work that is so, for he was much more distinguished for his industry and judgment, than for his genius. Also a multitude of papers in the Philosophical Transactions, in almost every volume, from the first to the twenty-fifth volume.

In 1697, the curators of the University press at Oxford thought it for the honour of the University to collect the Doctor's mathematical works, which had been printed separately, some in Latin, some in English, and published them all together in the Latin tongue, in three volumes, folio, 1699.

Dr. Wallis died at Oxford the 28th of October, 1703, in the eighty-eighth year of his age, leaving behind him one son and two daughters. We are told, that he was of a vigorous constitution, and of a mind which was strong, calm, serene, and not easily ruffled or discomposed. He speaks of himself, in his letter to Mr. Smith, in a strain which shows him to have been a very cautions and prudent man, whatever his secret opinions and attachments might be. He concludes; "It hath been my endeavour all along, to act by moderate principles, being willing, whatever side was uppermost, to promote any good design, for the true interest of religion, of learning, and of the public good."

WALRUS. See Trichecus.

WALTHERIA, in botany, so named in honour of Augustin Frederic Walther, Professor of Medicine at Leipsic, a genus of the Monadelphia Pentandria class and order. Natural order of Columniferæ. Tiliaceæ, Jussieu. Essential character: calyx double; outer lateral three-leaved, deciduous; petals five; style one; capsule one-celled, two-valved, one-seeded. There are six species.

WAPENTAKE (from the Saxon), the same with what we call a hundred, and more especially used in the northern

counties beyond the river Trent. There have been several conjectures as to the original of the word; one of which is, that anciently musters were made of the armour and weapons of the inhabitants of every hundred; and from those that could not find sufficient pledges of their good abearing, their weapons were taken away, and given to others; whence, it is said, this word is derived.

WARD (Dr. Seth), an English prelate, chiefly famous for his knowledge in mathematics and astronomy, was the son of an attorney, and born at Buntingford, Hertfordshire, in 1617 or 1618. From hence he was removed and placed a student in Sidney College, Cambridge, in 1632. Here he applied with great vigour to his studies, particularly to the mathematics, and was chosen fellow of his college.

The civil war breaking out, Ward was involved not a little in the consequences of it. He was ejected from his fellowship for refusing the covenant; against which he soon after joined, with several others, in drawing up that noted treatise, which was afterwards printed. Being now obliged to leave Cambridge, he resided for some time with certain friends about London, and at other times, at Aldbury, in Surry, with the noted mathematician Oughtred, where he prosecuted his mathematical studies.

He had not been long in this family before the visitation of the University of Oxford began; the effect of which was, that many learned and eminent persons were turned out, and among them Mr. Greaves, the Savilian professor of astronomy. This gentleman laboured to procure Ward for his successor, whose abilities in his way were universally known and acknowledged; and effected it; Dr. Wallis succeeding to the geometry professorship at the same time. Mr. Ward then entered himself of Wadham College, for the sake of Dr. Wilkins, who was the warden; and he presently applied himself to bring the astronomy lectures, which had long been neglected and disused, into repute again; and for this purpose he read them very constantly, never missing one reading day all the while he held the lecture.

In 1654, both the Savilian professors did their exercises, in order to proceed doctors in divinity; and when they were to be presented, Wallis claimed precedency. This occasioned a dispute; which being decided in favour of Ward, who was really the senior, Wallis went out grand compounder, and so obtained the precedency.

In 1659, Ward was chosen president of Trinity College, but was obliged at the Restoration to resign that place. He had amends made him, however, by being presented, in 1660, to the rectory of St. Laurence, Jury. The same year he was also installed precentor of the church of Exeter. In 1661, he became Fellow of the Royal Society, and Dean of Exeter; and the year following he was advanced to the bishopric of the same church. In 1667, he was translated to the see of Salisbury; and, in 1671, was made Chancellor of the order of the Garter; an honour which he procured to be permanently annexed to the see of Salisbury, after it had been held by laymen for above one hundred and fifty years.

Dr. Ward was one of those unhappy persons who have had the misfortune to survive their senses, which happened in consequence of a fever ill cured: he lived till the Revolution, but without knowing any thing of the matter; and died in January, 1689, about seventy-one years of age. He was the author of several Latin works in astronomy and different parts of the mathematics, which were thought excellent in their day, but their use has been superseded by later improvements and the Newtonian philosophy.

WARDMOTE, a court kept in every ward in London, usually called the wardmote court: and the wardmote inquest has power every year to inquire into, and present, all defaults concerning the watch and constables not doing their duty; that engines, &c. be provided against fire; persons selling ale and beer be honest, and suffer no disorders, nor permit gaming, &c.; that they sell in lawful measures; and searches be made for vagrants, beggars, and idle persons, &c. who shall be punished.

WARE, or Wear, in naval affairs, to cause a ship to change her course from one board to the other, by turning her stern to the wind. Hence it is used in the same sense of veering, and in opposition to tacking, in which the head is turned to the wind, and the stern to the leeward.

WARNING *piece*, in the military art, is the gun which is fired every night about sun-set, to give notice to the drums and trumpets of the army to beat and sound a retreat or tattoo, which is likewise called setting the watch.

Warning *wheel*, in a clock, is the third or fourth, according to its distance from the first wheel.

WARP, in the manufactures, is the

threads, whether of silk, wool, linen, hemp, &c. that are extended lengthwise on the weaver's loom; and across which the workman, by means of his shuttle, passes the threads of the woof, to form a cloth, ribband, fustian, or other matter. For a woollen stuff to have the necessary qualities, it is required that the threads of the warp be of the same kind of wool, and of the same fineness throughout; that they be sized with Flanders or parchment size, well prepared, and that they be in sufficient number with regard to the breadth of the stuff to be wrought. To warp a ship, is to shift her from one place to another, when the wind and tide will permit it without danger.

WARRANT, a præcipe, under hand and seal, to some officer, to bring any offender before the person granting it; and warrants of commitment are issued by the Privy Council, a secretary of state, or justice of peace, &c. where there has been a private information, or a witness has deposed against an offender. Any one under the degree of nobility may be arrested for a misdemeanor, or any thing done against the peace of the kingdom, by warrant from a justice of the peace; though if the person be a peer of the realm, he must be apprehended for a breach of the peace by warrant out of the King's Bench.

A general warrant to apprehend all persons suspected, without naming or particularly describing any person in special, is illegal and void for its uncertainty: for it is the duty of the magistrate, and ought not to be left to the officer, to judge of the ground of the suspicion. Also a warrant to apprehend all persons guilty of such a crime is no legal warrant; for the point upon which its authority rests, is a fact to be decided on a subsequent trial; namely, whether the person apprehended thereupon be guilty or not guilty. A warrant may be lawfully granted by any justice, for treason, felony, præmunire, or any offence against the peace; and it seems clear, that where a statute gives any one justice a jurisdiction over any offence, or a power to require any person to do a certain thing ordained by such statute, it impliedly gives a power to every such justice to make out a warrant to bring before him any one accused of such offence, or compelled to do any thing ordained by such statute; for it cannot but be intended, that a statute which gives a person jurisdiction over an offence, means also to give him the power incident to all courts, of compelling the party to come before him. But in cases where the King is not a party, or where no corporal punishment is appointed, as in cases for servants' wages, and the like, it seems that a summons is the more proper process; and for default of appearance, the justice may proceed; and so indeed it is often directed by special statutes. A warrant from any one of the justices of the Court of King's Bench extends over all the kingdom, and is tested or dated England; but a warrant of a justice of peace in one county must be backed, that is, signed by a justice of another county, before it can be executed there: and a warrant for apprehending an English or a Scotch offender may be indorsed in the opposite kingdom, and the offender carried back to that part of the united kingdom in which the offence was committed. This is also now extended to Ireland, upon a proper certificate of an indictment or information filed in either country.

WARRANT *of attorney*, is an authority and power given by a client to his attorney to appear and plead for him; or to suffer judgment to pass against him by confessing the action, by *nil dicit*, *non sum informatus*, &c. and although a warrant of attorney given by a man in custody to confess a judgment, no attorney being present, is void as to the entry of judgment, yet it may be a good warrant to appear and file common bail. A warrant of attorney to confess a judgment affords the best personal security that a creditor can have, and if together with it a saleable lease is pledged, it is perhaps the best security that can be had.

WARRANTY, a promise or covenant by deed, made by the bargainer for himself and his heirs, to warrant or secure the bargainee and his heirs against all men, for the enjoying any thing agreed on between them. Warranty is either real or personal; real, when it is annexed to lands or tenements granted for life, &c. and this is either in deed, as by the words "I warrant," expressly; or in law, as by the word *dedi*, "I have given," or some other amplification. Personal, which either respects the property of the thing sold, or the quality of it. Warranties in their more general divisions are of two kinds: first, a warranty in deed, or an express warranty, which is when a fine, or feoffment in fee, or a lease for life, is made by deed, which has an express clause of warranty contained in it; as when a conusor, feoffer, or lessor, covenants to warrant the land to the

conusee, feoffee, or lessee; secondly, a warranty in law, or an implied warranty, which is when it is not expressed by the party, but tacitly made and implied by the law. A warranty in deed is either lineal or collateral. A lineal warranty is a covenant real, annexed to the land by him who either was owner of or might have inherited the land, and from whom his heir lineal or collateral might possibly have claimed the land as heir from him that made the warranty. A collateral warranty is made by him that had no right, or possibility of right, to the land, and is collateral to the title of the land. On a sale of goods, the seller by implication warrants that he has a good title to them. See INSURANCE.

WARREN, a franchise, or place privileged, either by prescription or grant from the king, to keep beasts and fowl of warren in; as rabbits, hares, partridges, pheasants, &c.

WASH, among distillers, the fermentable liquor used by the malt distillers.

WASP. See VESPA.

WASTE, is the committing any spoil or destruction in houses, lands, &c. by tenants, to the damage of the heir, or of him in reversion or remainder; whereupon the writ or action of waste is brought for the recovery of the thing wasted, and damages for the waste done. There are two kinds of waste, voluntary or actual, and negligent or permissive. Voluntary waste may be done by pulling down or prostrating houses, or cutting down timber trees: negligent waste may be, by suffering an house to be uncovered, whereby the spars or rafters, planches, or other timber of the house, are rotten, or by not properly repairing. A writ of waste, to punish the offence after it has been committed, is an action partly founded upon the common law, and partly upon the statute of Gloucester; and may be brought by him that has the immediate state of inheritance in reversion or remainder against the tenant for life, tenant in dower, tenant by the courtesy, or tenant for years. This action of waste is a mixed action; partly real, so far as it recovers land; and partly personal, so far as it recovers damages; for it is brought for both those purposes; and if the waste be proved, the plaintiff shall recover the thing or place wasted, and also treble damages, by the said statute. 6 Edward I. c. 5. The writ of waste calls upon the tenant to appear, and show cause why he has committed waste and destruction, in the place named, to the disherison of the plaintiff. And if the defendant make default, or do not appear at the day assigned him, then the sheriff is to take with him a jury of twelve men, and go in person to the place alleged to be wasted, and there enquire of the waste done, and the damages, and make a return or report of the same to the court, upon which report the judgment is founded. The more common remedy is now by an action upon the case for damages only. A tenant at will is not liable for permissive waste, nor a tenant from year to year.

WATCH, in the art of war, a number of men posted at any passage, or a company of the guards who go on the patrol. At sea the term watch denotes a measure or space of four hours, because half the ship's company watch and do duty in their turn, so long at a time; and they are termed starboard watch and larboard watch.

WATCH is also used for a small portable movement or machine for the measuring of time, having its motion regulated by a spiral spring. Watches, strictly taken, are all such movements as show the parts of time; as clocks are such as publish it, by striking on a bell, &c. But commonly, the name watch is appropriated to such as are carried in the pocket, and clock to the large movements, whether they strike or not. See CHRONOMETER, CLOCK, HOROLOGY.

The several members of the watch part are, 1. The balance, consisting of the rim, which is its circular part; and the verge, which is its spindle, to which belong the two pallets, or levers, that play in the teeth of the crown wheel. 2. The potence, or pottance, which is the strong stud in pocket watches, whereon the lower pivot of the verge plays, and in the middle of which one pivot of the balance-wheel plays; the bottom of the potence is called the foot, the middle part the nose, and the upper part the shoulder. 3. The cock, which is the piece covering the balance. 4. The regulator, or pendulum spring, which is the small spring in new pocket watches, underneath the balance. 5. The pendulum, whose parts are the verge, pallets, cocks, and the bob. 6. The wheels, which are the crown-wheel in pocket pieces, and swing wheel in pendulums, serving to drive the balance or pendulum. 7. The contrate-wheel, which is that next the crown-wheel, &c. and whose teeth and hoop lie contrary to those of other wheels; whence the name. 8. The great or first wheel, which is that the fusee, &c. immediately drives: after

which are the second wheel, third wheel, &c. 9. Lastly, between the frame and dial-plate is the pinion of report, which is that fixed on the arbor of the great wheel, and serves to drive the dial-wheel as that serves to carry the hand.

Plate Watch represents the parts of a watch the proper size: fig. 1, is a plan of the wheel work, the upper plate (fig. 2) being removed to expose them; fig. 2 is the upper plate, the cock, F, (fig.5) being taken away to show the balance; fig. 3, the wheel work beneath the dial; fig. 4, a detached part; fig. 5, a general elevation of the whole, being supposed to be set out at length to show the whole at one view; fig. 6, the great wheel; fig. 7, the under side of the fusee; fig. 8, the main-spring, barrel, &c.

The essential difference between a clock and a watch consists in two particulars: first, it is moved by a spring in lieu of a weight; and, secondly, its motion is governed by a balance instead of a pendulum. The balance is a small wheel, *n*, (fig. 2 and 5, Plate Watch) fixed on an arbor, or axis, called the verge, and turning freely upon pivots at the ends of the arbor. To the axis of the balance the inner end of a very elastic spiral spring, *o*, called the pendulum spring, is fastened, and the outer end of the spiral is made fast to some fixture, *r*: in this state the balance will have a position of rest, which will be when the spiral spring, *o*, is in that position which it would assume when detached from the balance, and perfectly at liberty: now if the balance is turned round on its pivots by any external force in either direction, it will wind up or unwind the spiral spring, which will (when the external force is removed) return the balance to its state of rest; and as this is done with considerable velocity, the momentum the balance acquires by its motion will carry it beyond the point of rest on the other side. This again alters the spring, which returns the balance, throwing it beyond the point of rest; and in this manner the balance will vibrate, until the friction of the pivots and the resistance of the air destroys the original impulse. All vibrations of such a balance, which pass through eqnal spaces, will be performed in equal times.

This simple apparatus is all which is required for measuring time, the other mechanism of the watch being devoted to two objects: first, to give a small impulse to the balance at each vibration, to overcome the friction and resistance of the air, and cause the balance to describe equal arcs: and, secondly, to register the number of vibrations the balance has made.

The first of these objects requires a power which shall be in constant readiness to act upon the balance. This is accomplished by the re-action of a spiral steel spring, A, (fig. 8) which when at rest and liberty assumes that position and size; it is coiled up closer, and put into a brass box, *a*, called the spring barrel; a small hook which is at the outer end of the spring being put through a hole in the side of the box, *a*, small arbor, B, is put into the centre of the box, and the cover or lid of the box, D, is shut in: the arbor has a hook projecting from it, which enters a hole in the inner end of the spring A: its pivots project through the barrel at each side, and enter holes in the two plates E E, (fig. 5) which forms the frame of the watch; the lower pivot passes through the plate, and has a small rachet wheel, *b*, (fig. 3 and 5) fixed upon it, a click entering the teeth thereof prevents the arbor turning round; a small steel chain is hooked to the spring-barrel, *a*, (fig. 1 and 5); at one end it passes round the barrel several times, then round the fusee, *d*, and is hooked to it by its end. The fusee, *d*, is a conical piece of brass, with a spiral groove cut thereon to receive the chain: it is mounted on pivots which turn in holes, in the two plates, E E, and one of the pivots, *e*, projects a considerable distance, and is cut square. Now if a key is applied to this square, and the fusee, *d*, by that means turned round so as to wind the chain upon it, the spring barrel will be turned round, and the outer end of the spring, A, being hooked to the barrel, will be turned round also; as the inner end is immoveable, by being fixed to the arbor, B, the spring will be coiled up into a closer spiral than it was when at liberty, and will consequently exert a re-action upon the chain, and by that means upon the fusee, which will be turned round thereby when the key is removed. To prevent too much chain being wound upon the fusee, and by that means breaking the chain, or overstraining the spring, a contrivance called a guard is added: it is a small lever, *x* (fig. 1) moving on a stud fixed to the upper plate of the watch, and pressed downwards by a small spring, *z*: as the chain is wound upon the fusee, it rises in the spiral groove, and lifts up the lever, *x*, until it touches the upper plate: it is then in a position to intercept the edge of the spiral piece of metal seen on the top of the

fusee, and thus stop it from being wound up any further.

The power of the spring is transmitted to the balance by means of several cog wheels: the first, *f*, is upon the fusee; it is shown separated from the fusee in fig. 6, having a hole through the centre to receive the arbor of the fusee, and a projecting ring upon its surface; the under surface of the fusee is shown in fig. 7, having a circular groove cut in it to receive the corresponding ring upon the great wheel, fig. 6: the inner edge of the groove is cut with teeth to form a rachet wheel; when the wheel and fusee are put together, a small click, *g*, (fig 6) takes into the teeth of the rachet: as the fusee is turned by the key, to wind up the watch, this click slips over the sloping sides of the teeth without turning the great wheel; but when the fusee is turned the other way by the chain, the click catches the teeth of the rachet wheel, and causes the cog wheel to turn with the fusee; the great wheel, *f*, has forty-eight teeth, and turns a pinion of twelve teeth on an arbor in the centre of the watch, which carries the minute hand: a wheel, *h*, of fifty-four teeth, called the centre wheel, is fixed upon this arbor, and turns a pinion on the same arbor with the third wheel, *k*, of forty-eight teeth, which turns the pinion of the contrate wheel, *l*, of forty-eight teeth; the contrate wheel gives motion to a pinion of six teeth, and to the balance wheel, *m*, which has fifteen large teeth, which stop against two small pallets upon the arbor of the balance, or verge, *r*: these pallets are two small teeth, projecting from the verge at right angles to each other; one engages the upper side of the wheel, and the other takes the lower. By the action of the mainspring, *a*, the wheels are all turned; and the balance wheel, *m*, if there was no obstruction, would turn with great velocity until all the chain was wound off the fusee; but one of the pallets of the verge is always engaged with one of the teeth of the wheel, suppose one of the teeth on the lower side; now, by the balance turning round to make a vibration, the pallet allows the tooth to slip off, and the wheel begins to run down by the action of the main-spring, marking the vibrations by moving the hands, G H; it is, however, stopped immediately, by the next tooth at the top of the wheel meeting the upper pallet of the verge: the balance and pallet was at that time just beginning to return, and the top of the wheel moving in contrary direction to the bottom, the tooth presses against the pallet, and assists the balance to maintain the same arc in its vibration: when the balance is about to return, the upper tooth of the wheel slips off the pallet, and the lower one catches on the lower pallet, and assists the balance as before: one of the pivots of the balance wheel works in a small frame, *y*, called the pottance; the lower pivot of the verge works in the bottom of it also, and the upper pivot turns in a cock, F, screwed to the plate, E, and covering the balance to defend it from injury.

The hands, G H, are moved by the central arbor which projects through the lower plate, E, (fig. 5) and receives a pinion of twelve teeth fixed on the end of a tube which fits tight upon the arbor, but will slip round easily to set the hands when the watch is wrong: the other end of the tube is square, and receives the minute hand, H, which points out the minutes on a circle of sixty upon the dial plate, M M; the pinion on the tube turns a wheel, L, of forty-eight (seen in plans in fig. 3) on whose arbor is a wheel of sixteen, turning another wheel, K, of forty-eight, the arbor of which is a tube fitting on the other tube, and has the hour hand, G, fixed upon it; by this arrangement the minute hand, H, turns round twelve times for one revolution of the hour hand, G.

As the time the balance takes to perform a vibration depends upon the arc it passes through, the least increase of force in the main-spring would alter the rate of the watch; therefore the fusee is cut into a spiral, diminishing from top to bottom, as the spring draws the chain with greater force when wound up than when it is more released. The chain acts upon a shorter lever when the spring is wound up, and upon a longer when it is down, so as to regulate the unequal action of the spring to a perfectly regular force upon the wheel work.

As it will most probably happen that a watch will not always keep the same time, it is necessary to have an adjustment that may cause it to move faster or slower: this can be done by two ways, either by increasing or diminishing the force of the main-spring, *a*, which increases or diminishes the arc the balance describes; or it may be done by strengthening or weakening the pendulum spring, *o o*, which will cause the balance to move quicker or slower. The first is done by turning the rachet wheel, *b*, (fig. 5 and 3) on the end of the arbor of the main-spring, thereby

winding up or letting down the spring without turning the fusee; but as this is a very coarse adjustment, it is never used but by the maker, and recourse is had to the pendulum spring, *o*, (fig. 2) which is fixed to a stud, *r*, upon the plate, E, by one end, and the verge of the balance by the other: *p* is a small piece of metal, called the curb, having a notch in it to receive the spring: the acting part of the spring is from *p* to the centre; and as the curb, *p*, is moveable, the acting length can be altered: the curb is cut into teeth, and turned by a pinion, *q*, (fig. 4) which represents the piece, *s s s s s*, detached from the plate, E, and turned up: the pinion, *q*, has a small dial, divided into thirty, fixed to its arbor on the upper side of the plate, *s s*, by which it can be set so as to regulate the watch to the utmost nicety: *t t t t* (fig. 1) are four pillars, by which the two plates, E E, of the watch are held together; and *t t t t* (fig. 2) represent the heads of the same pillars coming through the upper plate, and small pins put through to keep the plate down.

WATER, a transparent fluid, without colour, smell, or taste, in a very small degree compressible; when pure, not liable to spontaneous change; liquid in the common temperature of our atmosphere, assuming the solid form at 32° Fahrenheit, and the gaseous at 212°, but returning unaltered to its liquid state on resuming any degree of heat between these points; capable of dissolving a greater number of natural bodies than any other fluid whatever, especially of those known by the name of the saline; performing the most important functions in the vegetable and animal kingdoms, and entering largely into their composition as a constituent part. Water is formed of hydrogen, combined with oxygen, in the proportion of 14.42 to 85.58. Water is assumed as the standard, or unity, in all tables of specific gravity. A cubic inch of it weighs, at thirty inches of the barometer, and 60° thermometer, 252,422 grains. Water does not enter the list of materia medica of any of the colleges; but it is so important, both as an article of diet, and as an agent in the cure of diseases, that a brief account of its varieties and properties cannot but be proper in this place. The purest natural water is melted snow, or rain, collected in the open fields. That which falls in towns, or is collected from the roofs of houses, is contaminated with soot, animal effluvia, and other impurities; although, after it has rained for some time, the quantity of these diminishes so much, that Morveau says, it may be rendered almost perfectly pure by means of a little barytic water, and exposure to the atmosphere. Rain water, after it falls, either remains on the surface of the earth, or penetrates through it until it meets with some impenetrable obstruction to its progress, when it bursts out at some lower part, forming a spring or well. The water on the surface of the earth either descends along its declivities in streams, which, gradually wearing channels for themselves, combine to form rivers, which at last reach the sea; or it remains stagnant in cavities of considerable depth, forming lakes or ponds, or on nearly level ground, forming marshes. Although the varieties of spring waters are exceedingly numerous, they may be divided into, 1. The soft, which are sufficiently pure to dissolve soap, and to answer the purposes of pure water in general. 2. The hard, which contain earthy salts, decompose soap, and are unfit for many purposes, both in domestic economy and manufactures. 3. The saline, which are strongly impregnated with soluble salts. When spring waters possess any peculiar character, they are called mineral waters. See WATERS, *mineral.*

River water is in general soft, as it is formed of spring water, which, by exposure becomes more pure; and running surface water, which, although turbid from particles of clay suspended in it, is otherwise very pure. Lake water is similar to river water. The water of marshes, on the contrary, is exceedingly impure, and often highly fetid, from the great proportion of animal and vegetable matters constantly decaying in them.

So early as the year 1776, an experiment was made by Macquer to ascertain what would be the product of the combustion of inflammable air, or hydrogen gas. He accordingly set fire to a bottle full of it, and held a saucer over the flame, but no soot appeared upon it as he expected, for it remained quite clean, and was bedewed with drops which were found to be pure water. Various conjectures were now formed about the nature of the product of the combustion of oxygen and hydrogen gases. By some it was supposed the carbonic acid gas; by others it was conjectured it would be the sulphurous or sulphuric acid. The latter was the opinion of M. Lavoisier. Such were the

experiments and opinions of the French chemists previously to the year 1781. About the beginning of that year, Mr. Warltire, a lecturer in natural philosophy, had long entertained an opinion that the combustion of hydrogen gas with atmospheric air, might determine the question, whether heat be a heavy body. Apprehensive of danger in making the experiment, he had for some time declined it, but was at last encouraged by Dr. Priestley, and accordingly prepared an apparatus for the purpose. This was a copper vessel properly fitted, and filled with atmospherical air and hydrogen gas, which was exploded by making the electric spark pass through it. A loss of weight of two grains was observed after the combustion. A similar experiment was repeated in close glass vessels, which, though clean and dry before the combustion, became immediately wet with moisture, and lined with a sooty matter. This sooty matter, Dr. Priestley afterwards supposed, proceeded from the mercury which had been employed in filling the vessel. During the same year Mr. Cavendish repeated the experiments of Mr. Warltire and Dr. Priestley. He performed them several times with atmospheric air and hydrogen gas, in a vessel which held 24,000 grains of water, and he never could perceive a loss of weight more than one-fifth of a grain, and often none at all. In all these experiments not the least sooty matter appeared in the inside of the glass. To examine the nature of the dew which appeared in the inside of the glass, he burnt 500,000 grain measures of hydrogen gas, with about two and a half times that quantity of common air; and in this combustion he obtained one hundred and thirty-five grains of water, which had neither taste nor smell, and when it was evaporated, left no sensible sediment. It seemed to be pure water. In another experiment, he exploded, in a glass globe, 19,500 grain measures of oxygen gas, and 37,000 of hydrogen gas, by means of the electric spark. The result of the experiment was thirty grains of water, which contained a small quantity of nitric acid. The experiments of Mr. Cavendish were made in the year 1781, and they are undoubtedly conclusive with regard to the composition of water. It would appear that Mr. Watt entertained the same ideas on this subject. When he was informed by Dr. Priestley of the result of these experiments, he observes, "Let us consider what obviously happens in the deflagration of hydrogen and oxygen gases. These two kinds of air unite with violence, they become red hot, and when cooling totally disappear. When the vessel is cooled, a quantity of water is found in it equal to the weight of the air employed. The water is then the only remaining product of the process; and water, light, and heat, are all the products, unless there be some other matter set free, which escapes our senses. Are we not then authorised to conclude, that water is composed of oxygen and hydrogen gases, deprived of part of their latent or elementary heat; that oxygen gas is composed of water, deprived of its hydrogen, and united to elementary heat and light; and that the latter are contained in it in a latent state, so as not to be sensible to the thermometer or to the eye? And if light be only a modification of heat, or a circumstance attending it, or a component part of the hydrogen gas, then oxygen gas is composed of water deprived of its hydrogen, and united to elementary heat." Thus it appears that Mr. Watt had a just view of the composition of water, and of the nature of the process by which its component parts pass to a liquid state from that of an elastic fluid. Towards the end of the same year, M. Lavoisier had made some experiments, the result of which surprised him; for the product of the combustion of the oxygen and hydrogen gases, instead of being sulphuric or sulphurous acid, as he expected it, was pure water. This led him to procure an apparatus, with which the experiment might be performed on a large scale, and with more accuracy and precision. Accordingly the experiments were performed on the twenty-fourth of June, 1783, in presence of several academicians, and also of Sir Charles Blagden, who was at that time in Paris. A similar experiment was afterwards performed by M. Monge, with the same result; and it was repeated again by Lavoisier and Meusnier, on a scale so large as to put the matter beyond a doubt. The conclusion, therefore, from the whole was, that water is composed of oxygen and hydrogen. Water exists in three different states; in the solid state, or state of ice, in the liquid, and in the state of vapour or steam. Its principal properties have already been detailed, in treating of the effects of caloric. It assumes the solid form when it is cooled down to the temperature of 32°. In this state it increases in bulk, by which it exerts a prodigious expansive force,

which is owing to the new arrangement of its particles, which assume a crystalline form, the crystals crossing each other at angles of 60° or 120°. The specific gravity of ice is less than that of water. When ice is exposed to a temperature above 32°, it absorbs caloric, which then becomes latent, and is converted into the liquid state, or that of water. At the temperature of $42\frac{1}{2}°$, water has reached its maximum of density. According to the experiments of Lefevre Gineaux, a French cubic foot of distilled water, taken at its maximum of density, is equal to 70 pounds, 223 grains French, equal 529,452.9492 troy grains. An English cubic foot at the same temperature weighs 437,102.4946 grains troy. By Professor Robinson's experiments it is ascertained, that a cubic foot of water, at the temperature of 55°, weighs 998.74 avoirdupois ounces, of 437.5 grains troy each, or about $1\frac{1}{4}$ ounce less than 1000 avoirdupois ounces. When water is exposed to the temperature of 212°, it boils; and if this temperature be continued, the whole is converted into an elastic invisible fluid, called vapour or steam. This, as has been already shown, is owing to the absorption of a quantity of caloric, which is necessary to retain it in the fluid form. In this state it is about 1800 times its bulk when in the state of water. This shows what an expansive force it must exert when it is confined, and hence its application in the steam engine, of which it is the moving power.

Waters, *mineral.* The complete and accurate analysis of mineral waters is one of the most difficult subjects of chemical research, and requires a very extensive acquaintance with the properties and habitudes of a numerous class of substances. Such minuteness, however, is scarcely ever required in the experiments that are subservient to the ordinary purposes of life, a general knowledge of the composition of bodies being sufficient to assist in directing the most useful applications of them. Instead, therefore, of giving a very ample detail of all the methods pointed out by Kirwan and others, we shall describe the means which are most generally useful in researches of this kind.

Before any proceeding is made in the analysis of a water, it is proper to inquire into its natural history, and to examine attentively its physical characters. The temperature of the water must be carefully observed, and the quantity inquired into, which it yields in a given time. The sensible qualities of taste, smell, degree of transparency, &c. are also best entertained at the fountain-head. The specific gravity of the water must also be found. See Gravity, *specific.*

The readiest way of judging of the contents of mineral waters is by applying tests or re-agents, the chief of which are the following:

Infusion of litmus is a test of most uncombined acids.

If the infusion redden the unboiled, but not the boiled water, we may infer, that the acid is volatile, and most probably, the carbonic. Sulphuretted hydrogen gas, dissolved in water, also reddens litmus, but not after boiling.

To ascertain whether the change be produced by carbonic acid, or by sulphuretted hydrogen, when experiment shows that the reddening cause is volatile, add barytic water. This, if carbonic acid be present, will occasion a precipitate, which will dissolve, with effervescence, on adding a little muriatic acid. Sulphuretted hydrogen may also be contained, along with carbonic acid, in the same water; which will be determined by the tests hereafter to be described. Paper tinged with litmus is also reddened by the presence of carbonic acid, but regains its blue colour on drying.

Infusion of Litmus reddened by Phosphoric Acid,—Tincture of Brazil-wood,—Tincture of Turmeric, and Paper stained with each of these three Substances,—Tincture of Red Cabbage.—All these different tests have one and the same object.

Infusion of litmus, reddened by phosphoric acid, or litmus paper reddened by it, has its blue colour restored by alkalies and earths, and by carbonated alkalies, and carbonated earths. Turmeric paper and tincture are changed to a reddish-brown by alkalies, whether freed from carbonic acid or not; by earths, freed from carbonic acid, but not by carbonated earths.

The red infusion of Brazil-wood, and paper stained with it, become blue by alkalies and earths, and even by the latter, when dissolved by an excess of carbonic acid. In the last mentioned case, however, the change will either cease to appear, or will be much less remarkable, when the water has been boiled.

Tincture of cabbage is, by the same causes, turned green; as is also paper stained with the juice of the violet, or with the scrapings of radishes.

Tincture of galls.—Tincture of galls is employed for discovering iron, with which it produces a black tinge. The iron, however, in order to be detected by this test, must be in the state of a red oxide, or, if oxydized in a less degree, its effects will not be apparent, unless after standing some time in contact with the air. By applying this test before and after evaporation, or boiling, we may know whether the iron be held in solution by carbonic acid, or by a fixed acid; for,

1. If it produce its effect before the application of heat, and not afterward, carbonic acid is the solvent.

2. If after, as well as before, a fixed and vulgarly called mineral acid is the solvent.

3. If, by the boiling, a yellowish powder be precipitated, and yet galls continue to strike the water black, the iron, as often happens, is dissolved, both by carbonic acid gas and by a fixed acid.

Sulphuric Acid.—Sulphuric acid discovers, by a slight effervescence, the presence of carbonic acid, whether uncombined or united with alkalies or earths.

2. If lime be present, the addition of sulphuric acid occasions, after a few days, a white precipitate.

3. Barytes is precipitated instantly, in the form of a white powder.

4. Nitric or muriatic salts, in a dry state, or dissolved in very little water, on adding sulphuric acid, and applying heat, are decomposed: and if a stopper, moistened with solution of ammonia, be held over the vessel, white clouds will appear. For distinguishing whether nitric or muriatic acid be the cause of this appearance, rules will be given hereafter.

Oxalic Acid and Oxalates.—This acid is a most delicate test of lime, which it separates from all its combinations.

1. If a water, which is precipitated by oxalic acid, become milky on adding a watery solution of carbonic acid, or by blowing air through it from the lungs, by means of a quill or glass tube, we may infer, that lime (or barytes, which has never yet been found pure in waters) is present in an uncombined state.

2. If the oxalic acid occasions a precipitate before, but not after boiling, the lime is dissolved by an excess of carbonic acid.

3. If after boiling, by a fixed acid. A considerable excess of any of the mineral acids, however, prevents the oxalic acid from occasioning a precipitate, even though lime be present; because some acids decompose the oxalic, and others, dissolving the oxalate of lime, prevent it from appearing. (Vide Kirwan on Waters, page 88.)

The oxalate of ammonia, or of potash, are not liable to the above objection, and are preferable as re-agents, to the uncombined acid. Yet even these oxalates fail to detect lime when supersaturated with muriatic or nitric acids; and if such an excess be present, it must be saturated, before adding the test, with ammonia. A precipitate will then be produced.

The quantity of lime, contained in the precipitate, may be known, by first igniting it with access of air, which converts the oxalate into a carbonate; and by expelling from this last the carbonic acid, by a strong heat, in a covered crucible. According to Dr. Marcet, 117 grains of sulphate of lime give 100 of oxalate of lime, dried at 160° Fahrenheit.

Fluate of ammonia is also a most delicate test of lime.

Barytic Water.—1. Barytic water is a very effectual test for detecting the presence of carbonic acid, with which it forms a precipitate, which is soluble with effervescence in dilute nitric, or better in muriatic acid.

2. Barytic water is also a most sensible test of sulphuric acid and its combinations, which it indicates by a precipitate not soluble in muriatic acid.

Metals.—Of the metals, silver, bismuth, and mercury, are tests of the presence of hydro-sulphurets, and of sulphuretted hydrogen-gas. If a little quicksilver be put into a bottle, containing water impregnated with either of these substances, its surface soon acquires a black film, and, on shaking the bottle, a blackish powder separates from it. Silver leaf and bismuth are speedily tarnished by the same cause.

Sulphate, Nitrate, aud Acetate of Silver.—These solutions are all, in some measure, applicable to the same purpose.

They are peculiarly adapted to the discovery of muriatic acid and of muriates, with which they form a white precipitate. A precipitation, however, may arise from other causes, which it may be proper to state. The solutions of silver in acids are precipitated by carbonated alkalies and earths. The agency of the alkalies and earths may be prevented, by previously saturating them with a few drops of the same acid in which the silver

is dissolved. The nitrate and acetate of silver are decomposed by the sulphuric and sulphureous acids; but this may be prevented, by adding, previously, a few drops of nitrate or acetate of barytes, and after allowing the precipitate to subside, the clear liquor may be decanted, and the solution of silver added. Should a precipitate now take place, the presence of muriatic acid, or some of its combinations, may be suspected. To obviate uncertainty, whether a precipitate be owing to sulphuric or muriatic acid, a solution of sulphate of silver may be employed, which, when no uncombined alkali, or earth, is present, is affected only by the latter acid.

The solutions of silver are also precipitated by sulphuretted hydrogen, and by hydro-sulphurets; but the precipitate is then reddish, or brown, or black; or it may be at first white, and afterwards become speedily brown or black. It is soluble, in great part, in dilute nitrous acid, which is not the case if occasioned by muriatic or sulphuric acid.

The solutions of silver are precipitated by extractive matter; but in this case also the precipitate has a dark colour, and is soluble in nitrous acid.

Acetate of Lead.—Acetate of lead is a test of sulphuretted hydrogen and of hydro-sulphurets of alkalies, which occasion a black precipitate; and if a paper, on which characters are traced with a solution of acetate of lead, be held over a portion of water containing sulphuretted hydrogen gas, they are soon rendered visible, especially when the water is a little warmed.

Muriate, Nitrate, and Acetate of Barytes.—These solutions are all most delicate tests of sulphuric acid and of its combinations, with which they give a white precipitate, insoluble in dilute muriatic acid. They are decomposed, however, by carbonated alkalies; but the precipitates, occasioned by carbonates, are soluble in dilute muriatic or nitric acid, with effervescence, and may even be prevented by adding previously a few drops of the same acid as that contained in the barytic salt, which is employed.

One hundred grains of dry sulphate of barytes contain (according to Klaproth, vol. i. p. 168.) about 45½ of sulphuric acid, of the specific gravity 1850: according to Clayfield, (Nicholson's Journal, 4to. iii. 38.) 33 of acid, of specific gravity 2240; according to Thevnard, after calcination, about 25; and according to Mr. Kirwan, after ignition 23.5 of real acid. The same chemist states, that 170 grains of ignited sulphate of barytes denote 100 of dried sulphate of soda; while 136.36 of the same substance indicate 100 of dry sulphate of potash; and 100 parts result from the precipitation of 52.11 of sulphate of magnesia.

From Klaproth's experiments, it appears that 1000 grains of sulphate of barytes indicate 595 of desicated sulphate of soda, or 1416 of the crystallized salt. The same chemist has shown, that 100 grains of sulphate of barytes are produced by the precipitation of 71 grains of sulphate of lime.

Prussiates of Potash and of Lime.—Of these two, the prussiate of potash is the most eligible. When pure, it does not speedily assume a blue colour, on the addition of an acid, nor does it immediately precipitate muriate of barytes.

Prussiate of potash is a very sensible test of iron, with the solutions of which in acids it produces a Prussian blue precipitate, in consequence of a double elective affinity. To render its effects more certain, however, it may be proper to add, previously to any water suspected to contain iron, a little muriatic acid, with a view to the saturation of uncombined alkalies or earths, which, if present, prevent the detection of very minute quantities of iron.

1. If a water, after boiling and filtration, does not afford a blue precipitate, on the addition of prussiate of potash, the solvent of the iron may be inferred to be a volatile one, and probably the carbonic acid.

2. Should the precipitation ensue in the boiled water, the solvent is a fixed acid, the nature of which must be ascertained by other tests.

In using the prussiate of potash for the discovery of iron, considerable caution is necessary, in order to attain accurate results. The prussiate should, on all occasions, be previously crystallized; and the quantity of oxide of iron essential to its constitution, or at least an invariable accompaniment, should be previously ascertained in the following manner: Expose a known weight of the crystallized salt to a low red heat in a silver crucible. After fusing and boiling up, it will become dry, and will then blacken. Let it cool; wash off the soluble part; collect the rest on a filter; dry it, and again calcine it with a little wax. Let it be again weighed, and the result will show the proportion of oxide of iron present in the salt which has been examined. This varies from 22 to 30 and

upwards per cent. When the test is employed for discovering iron, let a known weight of the salt be dissolved in a given quantity of water: add the solution gradually; and observe how much is expended in effecting the precipitation. Before collecting the precipitate, warm the liquid, which generally throws down a further portion of Prussian blue. Let the whole be washed and dried, and then ignited with wax. From the weight of the oxide obtained, deduct that quantity, which, by the former experiment, is known to be present in the prussiate that has been added; and the remainder will denote the quantity of oxide of iron present in the liquor which is under examination.

Succinate of Soda and Succinate of Ammonia are also tests for iron.

In applying these agents it is necessary not to use more than is sufficient for the purpose; because an excess of them redissolves the precipitate. The best mode of proceeding is, to heat the solution containing iron, and to add gradually the solution of succinate, until it ceases to produce any effect. A brownish precipitate is obtained, consisting of succinate of iron. This, when heated with a little wax, in a low red heat, gives an oxide of iron, containing about seventy per cent. of the metal.

The succinates, however, precipitate alumine, provided there be no considerable excess of acid in the aluminous salt. On magnesia they have no action, and hence they may be successfully employed in the separation of these two earths.

Phosphate of Soda.—An easy and valuable method of precipitating magnesia has been suggested by Dr. Wollastan. It is founded on the property which fully neutralized carbonate of ammonia possesses; first to dissolve the carbonate of magnesia formed, when it is added to the solution of magnesian salt. For this purpose a solution of carbonate of ammonia, prepared with a portion of that salt which has been exposed, spread on a paper, for a few hours to the air, is to be added to the solution of the magnesian salt sufficiently concentrated; or to a water suspected to contain magnesia, after being very much reduced by evaporation. No precipitate will appear, till a solution of phosphote of soda is added, when an abundant one will fall down. Let this be dried in a temperature not exceeding 100° Fahrenheit. One hundred grains of it will indicate nineteen of magnesia, or about sixty-four of muriate of magnesia.

Muriate of Lime.—Muriate of lime is principally of use in discovering the presence of alkaline carbonates, which, though they very rarely occur, have sometimes been found in mineral waters. Of all the three alkaline carbonates, muriate of lime is a sufficient re-agent; for those salts separate from it a carbonate of lime, soluble, with effervescence, in muriatic acid.

With respect to the discrimination of the different alkalies, potash may be detected by muriate of platina. Carbonate of ammonia may be discovered by its smell; and by its precipitating a neutral salt of alumine, while it has no action apparently on magnesian salts.

To estimate the proportion of an alkaline carbonate present in any water, saturate its base with sulphuric acid, and note the weight of real acid which is required. Now 100 grains of real sulphuric acid saturate 121.48 potash, and 78.32 soda.

Analysis of waters by evaporation.—The reader, who may wish for rules for the complete and accurate analysis of mineral waters, will find in almost every chemical work a chapter allotted to this subject. He may consult Kirwan's "Essay on the Analysis of Mineral Waters," London, 1799.

Before evaporation, however, the gaseous products of the water must be collected, which may be done by filling with it a large glass bottle, or retort, capable of holding about fifty cubic inches, and furnished with a ground stopper and bent tube. The bottle is to be placed up to its neck in a kettle filled with brine, which must be kept boiling for an hour or two, renewing, by fresh portions of hot water, what is lost by evaporation. The disengaged gas is conveyed, by a bent tube, into a graduated jar, filled with, and inverted in, mercury, where its bulk is to be determined. On the first impression of the heat, however, the water will be expanded, and portions will continue to escape into the graduated jar, till the water has obtained its maximum of temperature. This must be suffered to escape, and its quantity to be deducted from that of the water submitted to experiment.

In determining, with precision, the quantity of gas, it is necessary to attend to the state of the barometer and thermometer.

The gases most commonly found in mineral waters, are *carbonic acid; sulphuretted hydrogen; nitrogen; oxygen gas;* and, in the neighbourhood of volcanoes only, *sulphureous acid gas.*

To determine the proportion of the gases, constituting any mixture obtained from a mineral water in the foregoing manner, the following experiments may be made. If the use of re-agents has not detected the presence of sulphuretted hydrogen, and there is reason to believe, from the same evidence, that carbonic acid forms a part of the mixture, let a graduated tube be nearly filled with it over quicksilver; pass up a small portion of solution of potash, and agitate this in contact with the gas; the amount of the diminution will show how much carbonic acid has been absorbed; and, if the quantity submitted to experiment was an aliquot part of the whole gas obtained, it is easy to infer the total quantity present in the water. The unabsorbable residuum consists, most probably, of oxygen and azotic gases; and the proportion of these two is best learned by the use of Dr. Hope's eudiometer.

If sulphuretted hydrogen be present, along with carbonic acid, the separation of these two is a problem of some difficulty. Mr. Kirwan recommends, that a graduated glass vessel, completely filled with the mixture, be removed into a vessel containing nitrous acid. This instantly condenses the sulphuretted hydrogen, but not the carbonic acid gas. It seems to be a more eligible mode to condense the sulphuretted hydrogen by oxymuriatic acid gas (obtained from muriatic and hyper-oxymuriate of potash,) adding the latter gas very cautiously, as long as it produces any condensation. Or, perhaps, a better plan of effecting the separation is the following, recommended by Mr. Henry: half fill a graduated phial with the mixed carbonic acid and sulphuretted hydrogen gases, and expel the rest of the water by oxymuriatic acid gas. Let the mouth of the bottle be then closed with a well ground stopper, and let the mixture be kept twenty-four hours. Then withdraw the stopper under water, a quantity of which fluid will immediately rush in. Allow the bottle to stand half an hour without agitation. The redundant oxymuriatic acid gas will thus be absorbed; and very little of the carbonic acid will disappear. Supposing that, to ten cubic inches of the mixed gases, ten inches of oxymuriatic gas have been added, and that, after absorption, by standing over water, five inches remain, the result of this experiment shows that the mixture consisted of equal parts of sulphuretted hydrogen and carbonic acid gases.

Whenever this complicated admixture of gases occurs, as in the Harrowgate, and in some of the Cheltenham waters, it is advisable to operate separately on two portions of gas, with the view to determine, by the one, the quantity of carbonic acid and sulphuretted hydrogen; and that of azote and oxygen by the other. In the latter instance, remove both the absorbable gases by caustic potash, and examine the remainder in the manner already directed.

Nitrogen gas sometimes occurs in mineral waters, almost in an unmixed state. When this happens, the gas will be known by the characters already described as belonging to it. Sulphureous acid gas may be detected by its peculiar smell of burning sulphur, and by its discharging the colour of an infusion of roses, which has been reddened by the smallest quantity of any acid adequate to the effect.

(*a*) The water should next be evaporated to dryness. The dry mass, when collected and accurately weighed, is to be put in a bottle, and highly rectified alcohol poured on it, to the depth of an inch. After having stood a few hours, and been occasionally shaken, pour the whole on a filter, wash it with a little more alcohol, and dry and weigh the remainder.

(*b*) To the undissolved residue add nine times its weight of cold distilled water; shake the mixture frequently; and, after some time, filter; ascertaining the loss of weight.

(*c*) Boil the residuum, for a quarter of an hour, in something more than five hundred times its weight of water, and afterwards filter.

(*d*) The residue, which must be dried and weighed, is no longer soluble in water or alcohol. If it has a brown colour, denoting the presence of iron, let it be moistened with water, and exposed to the sun's rays for some weeks.

I. The solution in alcohol (*a*) may contain one or all of the following salts: muriates of lime, magnesia, or barytes, or nitrates of the same earths. Sometimes, also, the alcohol may take up sulphate of iron, in which the metal is highly oxydized, as will appear by its reddish-brown colour.

1. In order to discover the quality and quantity of the ingredients, evaporate to dryness; weigh the residuum; add above half its weight of strong sulphuric acid; and apply a moderate heat. The muriatic or nitric acid will be expelled, and will be known by the colour of their

fumes; the former being white, and the latter orange-coloured.

2. To ascertain whether lime or magnesia be the basis of the salts, let the heat be continued till no more fumes arise, and let it then be raised to expel the excess of sulphuric acid. To the dry mass, add twice its weight of distilled water. This will take up the sulphate of magnesia, and leave the sulphate of lime. The two sulphates may be separately decomposed, by boiling with three or four times their weight of carbonate of potash. The carbonates of lime and magnesia, thus obtained, may be separately dissolved in muriatic acid, and evaporated. The weight of the dry salts will inform us how much of each the alcohol had taken up. Lime and magnesia may also be separated by the use of phosphate of soda.

II. The watery solution (*b*) may contain a variety of salts, the accurate separation of which from each other is a problem of considerable difficulty.

1. The analysis of this solution may be attempted by crystallization. For this purpose let one half be evaporated by a very gentle heat, not exceeding 80° or 90°. Should any crystals appear on the surface of the solution, while hot, in the form of a pellicle, let them be separated and dried on bibulous paper. These are muriate of soda, or common salt. The remaining solution, on cooling very gradually, will perhaps afford crystals distinguishable by their form and other qualities. When various salts, however, are contained in the same solution, it is extremely difficult to obtain them sufficiently distinct to ascertain their kind.

2. The nature of the saline contents must therefore be examined by tests, or re-agents.

The presence of an uncombined alkali, as well as uncombined acids, will be discovered by the stained papers, and tests already pointed out. The vegetable alkali, or potash, may be distinguished from the mineral, or soda, by muriate of platina.

If neutral salts be present in the solution, we have to ascertain both the nature of the acid, and that of the base. This may be done by attention to the rules already given for the application of tests, which it is unnecessary to repeat in this place.

III The solution by boiling water contains scarcely any thing besides sulphate of lime.

IV. The residuum (*d*) is to be digested in distilled vinegar, which takes up magnesia and lime, but leaves, undissolved alumine and highly oxydized iron. Evaporate the solution to dryness. If it contain acetate of lime only, a substance will be obtained which does not attract moisture from the air; if magnesia be present, the mass will deliquesce. To separate the lime from the magnesia, proceed as in I.

The residue, insoluble in acetous acid, may contain alumine, iron, and silex. The two first may be dissolved by muriatic acid, from which the iron may be precipitated, first by prussiate of potash, and the alumine afterward by a fixed alkali.

Water *ordeal*, or Trial, among our ancestors, was of two kinds, by hot and by cold water. Trial, or purgation, by boiling or hot water, was a way of proving crimes, by immerging the body, or the arm, in hot water, with divers religious ceremonies. In the judgment by boiling water, the accused, or he who personated the accused, was obliged to put his naked arm into a cauldron full of boiling water, and to draw out a stone thence, placed at a greater or less depth, according to the quality of the crime. This done, the arm was wrapped up, and the judge set his seal on the cloth, and at the end of three days they returned to view it, when, if it were found without any scald, the accused was declared innocent. The nobles or great personages purged themselves thus, by hot water, and the populace by cold water. The trial, or purgation, by cold water, was thus: after certain prayers and other ceremonies, the accused was swaddled, or tied up, all in a pelotoon or lump, and thus cast into a river, lake, or vessel, of cold water, where, if he sunk, he was held criminal, if he floated, innocent.

Water *bailiff*, is an officer in sea-port towns, appointed for the searching of ships; and in London, the water bailiff hath the supervising and search of fish, brought thither; and the gathering of the toll arising from the Thames; his office is likewise to arrest men for debt, &c. or other personal or criminal matters, upon the river Thames.

Water *spout*, an extraordinary meteor, most frequently observed at sea. It generally begins by a cloud, which appears very small, and which is called by the sailors the squall: this augments in a little time into an enormous cloud of a cylindrical form, or that of a cone on its apex, and produces a noise like the roar-

ing of an agitated sea, sometimes accompanied with thunder and lightning, and also large quantities of rain or hail, sufficient to inundate large vessels, and carry away in their course, when they occur by land, trees, houses, and every thing that oppose their impetuosity. Sailors, dreading the fatal consequences of water spouts, endeavour to dissipate them by firing a cannon into them just before they approach the ship. We shall give an account of one as described by M. Tournefort, in his Voyage to the Levant.

"The first of these," says this traveller, "that we saw, was about a musquet-shot from our ship. There we perceived the water began to boil, and to rise about a foot above its level. The water was agitated and whitish; and above its surface there seemed to stand a smoke, such as might be imagined to come from wet straw before it begins to blaze. It made a sort of a murmuring sound, like that of a torrent heard at a distance, mixed, at the same time, with a hissing noise, like that of a serpent: shortly after we perceived a column of this smoke rise up to the clouds, at the same time whirling about with great rapidity. It appeared to be as thick as one's finger; and the former sound still continued. When this disappeared, after lasting for about eight minutes, upon turning to the opposite quarter of the sky, we perceived another, which began in the manner of the former: presently after a third appeared in the west; and instantly beside it still another arose. The most distant of these three could not be above a musket-shot from the ship. They all continued like so many heaps of wet straw set on fire, that continued to smoke, and to make the same noise as before. We soon after perceived each, with its respective canal, mounting up in the clouds; and spreading, where it touched the cloud, like the mouth of a trumpet; making a figure, to express it intelligibly, as if the tail of an animal was pulled at one end by a weight. These canals were of a whitish colour, and so tinged, as I suppose, by the water which was contained in them; for, previous to this, they were apparently empty, and of the colour of transparent glass. These canals were not straight, but bent in some parts, and far from being perpendicular, but rising in their clouds with a very inclined ascent. But what is very particular, the cloud to which one of them was pointed happening to be driven by the wind, the spout still continued to follow its motion without being broken; and passing behind one of the others, the spouts crossed each other in the form of a St. Andrew's cross. In the beginning they were all about as thick as one's finger, except at the top, where they were broader, and two of them disappeared; but shortly after the last of the three increased considerably, and its canal, which was at first so small, soon became as thick as a man's arm, then as his leg, and at last thicker than his whole body. We saw distinctly, through this transparent body, the water, which rose up with a kind of spiral motion; and it sometimes diminished a little of its thickness, and again resumed the same; sometimes widening at top, and sometimes at bottom; exactly resembling a gut filled with water, pressed with the fingers, to make the fluid rise or fall; and I am well convinced that this alteration in the spout was caused by the wind, which pressed the cloud, and compelled it to give up its contents. After some time its bulk was so diminished as to be no thicker than a man's arm again, and thus swelling and diminishing, it at last became very small. In the end, I observed the sea, which was raised about it, to resume its level by degrees, and the end of the canal that touched it to become as small as if it had been tied round with a cord; and this continued till the light, striking through the cloud, took away the view. I still, however, continued to look, expecting that its parts would join again, as I had before seen in one of the others, in which the spout was more than once broken, and yet again came together; but I was disappointed, for the spout appeared no more."

In the Philosophical Transactions we have descriptions of several; their effects, in some instances, are probably much exaggerated. One at Topsham is said to have cut down an apple-tree, several inches in diameter: another, we are told, seemed to be produced by a concourse of winds, turning like a screw, the clouds dropping down into it: it threw trees and branches about with a gyratory motion. See Philosophical Transactions, vol. xxii. and xxiii. One in Deeping Fen, Lincolnshire, was first seen moving across the land and water of the fen: it raised the dust, broke some gates, and destroyed a field of turnips: it vanished with an appearance of fire. Dr. Franklin supposes that a vacuum is made by the rotatory motion of the ascending air, as when water is running through a funnel, and that the water of the sea is thus rais-

ed. But Dr. Young says, no such cause could do more than produce a slight rarefaction of the air, much less raise the water to the height of thirty or forty feet, or more.

Professor Wolke describes a water spout which passed immediately over the ship in which he was sailing, in the Gulph of Finland; it appeared to be twenty-five feet in diameter, consisting of drops about the size of cherries. The sea was agitated round its base, through a space of about one hundred and thirty feet in diameter. One of the latest accounts of the phenomenon of a water-spout is that read to the Royal Society in the year 1803, from a letter written to Sir Joseph Banks, by Captain Ricketts, of the royal navy:

"In the month of July, 1800, Captain Ricketts was called on deck, on account of the rapid approach of a water-spout, among the Lipari islands. It had the appearance of a viscid fluid, tapering in its descent, proceeding from the cloud to join the sea. It moved at the rate of about two miles an hour, with a loud sound of rain. It passed the stern of the ship, and wetted the after-part of the main-sail: hence it was inferred, that water-spouts are not continuous columns of water; and subsequent observations confirmed the opinion. In November, 1801, about twenty miles from Trieste, a water-spout was seen eight miles to the south; round its lower extremity was a mist, about twelve feet high, somewhat of the form of an Ionian capital, with very large volutes, the spout resting obliquely on its crown. At some distance from this spout the sea began to be agitated, and a mist rose to the height of about four feet: then a projection descended from the black cloud that was impending, and met the ascending mist about twenty feet above the sea: the last ten yards of the distance were described with very great rapidity. A cloud of a light colour appeared to ascend in this spout something like quicksilver in a tube. The first spout then snapped at about one-third of its height, the inferior part subsiding gradually, and the superior curling upwards. Several other projections from the cloud appeared, with corresponding agitations of the water below, but not always in spots vertically under them: seven spouts in all were formed; two other projections were reabsorbed. Some of the spouts were not only oblique but curved: the ascending cloud moved most rapidly in those which were vertical; they lasted from three to five minutes, and their dissipation was attended by no fall of rain.

WAVE, in physics, a volume of water elevated by the action of the wind, &c. upon its surface, into a state of fluctuation, and accompanied by a cavity. The extent from the bottom or lowest point of one cavity, and across the elevation, to the bottom of the next cavity, is the breadth of the wave. Waves are considered as of two kinds, which may be distinguished from one another by the names of natural and accidental waves. The natural waves are those which are regularly proportioned in size to the strength of the wind which produces them. The accidental waves are those occasioned by the wind's reacting upon itself by repercussion from hills or high shores, and by the dashing of the waves themselves, otherwise of the natural kind, against rocks and shoals; by which means these waves acquire an elevation much above what they can have in their natural state.

Mr. Boyle proved, by numerous experiments, that the most violent wind never penetrates deeper than six feet into the water; and it seems a natural consequence of this, that the water moved by it can only be elevated to the same height of six feet from the level of the surface in a calm; and these six feet of elevation being added to the six of excavation, in the part from whence that water so elevated was raised, should give twelve feet for the utmost elevation of a wave. This is a calculation that does great honour to its author; as many experiments and observations have proved that it is very nearly true in deep seas, where the waves are purely natural, and have no accidental causes to render them larger than their just proportion.

It is not to be understood, however, that no wave of the sea can rise more than six feet above its natural level in open and deep water; for waves vastly higher than these are formed in violent tempests in the great seas. These however are not to be accounted waves in their natural state, but as compound waves formed by the union of many others; for in these wide plains of water, when one wave is raised by the wind, and would elevate itself up to the exact height of six feet, and no more, the motion of the water is so great, and the succession of waves so quick, that while this is rising, it receives into it several other waves, each of which

would have been at the same height with itself; these run into the first wave one after another, as it is rising; by which means its rise is continued much longer than it naturally would have been, and it becomes accumulated to an enormous size. A number of these complicated waves rising together, and being continued in a long succession by the continuation of the storm, make the waves so dangerous to ships, which the sailors in their phrase call mountains high.

"The Motion of the Waves" makes an article in the Newtonian philosophy; the author having explained their motions, and calculated their velocity from mathematical principles, similar to the motion of a pendulum, and to the reciprocation of water in the two legs of a bent and inverted syphon or tube. See PRINCIPIA.

"Stilling Waves by means of Oil." This wonderful property, though well known to the ancients, as appears from the writings of Pliny, was for many ages either quite unnoticed, or treated as fabulous by succeeding philosophers. By means of Dr. Franklin, the subject again attracted the attention of the learned; though it appears from some anecdotes, that seafaring people have always been acquainted with it. Mr. Pennant, in his British Zoology, vol. iv. under the article Seal, takes notice that when these animals are devouring a very oily fish, which they always do under water, the waves above are remarkably smooth; and by this mark the fishermen know where to find them. Sir Gilbert Lawson, who served long in the army at Gibraltar, assured Dr. Franklin, that the fishermen in that place are accustomed to pour a little oil on the sea, in order to still its motion, that they may be enabled to see the oysters lying at its bottom, which are there very large, and which they take up with a proper instrument. A similar practice obtains among fishermen in various other parts; and Dr. Franklin was informed by an old sea-captain, that the fishermen of Lisbon, when about to return into the river, if they saw too great a surf upon the bar, would empty a bottle or two of oil into the sea, which would suppress the breakers, and allow them to pass freely.

The doctor having revolved in his mind all these pieces of information, became impatient to try the experiment himself. At last, having an opportunity of observing a large pond very rough with the wind, he dropped a small quantity of oil upon it. But having at first applied it on the lee-side, the oil was driven back again upon the shore. He then went to the windward side, and poured on about a tea-spoon full of oil; this produced an instant calm over a space several yards square, which spread amazingly, and extended itself gradually till it came to the lee-side; making all that quarter of the pond, perhaps half an acre, as smooth as glass. This experiment was often repeated in different places, and always with success.

WAVED, WAVY, or WAVEY, in heraldry, is said of a bordure, or any ordinary, or charge, in a coat of arms, having its outlines indented in manner of the rising and falling of waves: it is used to denote, that the first of the family in whose arms it stands, acquired its honours for sea-service.

WAX. There are two or three substances which resemble each other so closely as to have received the name of wax. The first, and by far the most important, is bees' wax, which is consumed in such vast quantities for giving light; and is also used for a variety of other purposes. Another kind of wax is the myrtle wax, which is extracted pretty largely in Louisiana, and some other parts of America, from the myrica cerifera. Another substance very similar to wax is the pe la of the Chinese, the product of an insect, the exact species of which is not known; and the white matter which yields the laccic acid has also a strong resemblance to wax. The properties which all these substances have in common are, fusibility at a moderate heat; when kindled, burning with much flame; insolubility in water, solubility in alkalies, and also in alcohol and ether. In these two latter properties all the species of wax differ from the concrete oils, with which, in other respects, they have a very strong resemblance. Bees' wax is the substance, excreted from the body of the bee, of which these insects construct their cells, both those for containing honey and for the lodgment of their young. It is collected for the use of man wherever bees are kept. A young hive will yield at the end of the season about a pound of wax; and an old hive about twice as much. The colour of wax when fresh from the bee, is nearly white, but it soon grows considerably yellow in the hive, or if very old is of a dark brown. The wax which is the ordinary bees' wax of the shops, is a pale yellow substance, of an agreeable honey-like smell, soft, and somewhat unctuous to the touch, but with-

out sticking to the fingers, in winter becoming considerably hard and tough, and melting at about 142° This yellow colour and the smell of wax are entirely taken away by exposing it, when divided into thin laminæ, to the united action of the light and air, and by this means it becomes perfectly white, scentless, somewhat harder and less greasy to the touch, and in this state it is employed for candles and many other purposes. Bleached wax burns with a very pure white light, and gives no offensive smell, and very little smoke compared with tallow.

Being less fusible than tallow it requires a smaller wick. Bleached wax melts at about 155°, or 7° higher than the unbleached. Its specific gravity is less than that of water, being about .96. Alcohol has no sensible action on wax when cold, but on boiling it dissolves rather less than 1-20th of its weight of wax, the greater part of which separates when cold in the form of white flocculi, and what remains in solution is entirely precipitated by water. Wax is soluble abundantly in the fixed oils; but very sparingly in the essential oils. It is usually supposed that the wax is the pollen of of flowers, which the bees visibly collect on their thighs, and afterwards elaborate in some unknown way. The great difference between wax and this matter which the bees collect, has however been long remarked. When examined by the microscope, this little mass of pollen is obviously composed of a number of hard grains compressed together, and if it is laid on a hot plate, it does not melt as wax would do, but smokes, dries, and is reduced to a coal, and if kindled it burns without melting. Some late very curious experiments of Huber, one of the most celebrated apiarists in Europe, has further shown that the pollen has no share whatever in the formation of wax, but that this latter substance is produced indiscriminately from honey, sugar, or any other saccharine matter which serves as food for the bees.

WAY, a passage or road. The Roman ways are divided into consular, prætorian, military, and public; and of these we have four remarkable ones in England: first, Watling-street, or Watheling-street, leading from Dover to London, Dunstable, Towcester, Atterston, and the Severn, extending as far as Anglesea in Wales. The second, called Hikenild, or Ikenild-street, stretches from Southampton over the river Isis, at Newbridge; thence by Camden and Lichfield; then passes the Derwent, near Derby, and ends at Tinmouth. The third, called Fosse way, because in some places it was never perfected; but lies as a large ditch, leads from Cornwall through Devonshire, by Tethbury, near Stow in the Wolds; and beside Coventry to Leicester, Newark, and so to Lincoln. The fourth, called Erming, or Erminage-street, extends from St. David's, in Wales, to Southampton

WAY, in law. A way may be by prescription, as, if the owners and occupiers of such a farm have immemorially used to cross another's ground; for this immemorial usage implies an original grant. A right of way may also arise by act and operation of law; for if a man grant to another a piece of ground in the middle of his field, he at the same time tacitly gives him a way to come at it; for where the law gives any thing to any person, it gives implied whatever is necessary for enjoying the same.

WAY, *milky*. See GALAXY.

WAY *of a ship*, is sometimes the same as her rake, or run forward or backward: but this term is most commonly understood of her sailing. Thus when she goes apace, it is said, that she hath a good way, or makes a fresh way. So when an an account is kept how fast she sails by the log, it is called keeping an account of her way; and because most ships are apt to fall a little to leeward of their true course, they always, in casting up the log board, allow something for her leeward way

WAY *of the rounds*, in fortification, is a space left for the passage of the rounds between the rampart and the wall of a fortified town. This is not now much in use; because the parapet, not being above a foot thick, is soon overthrown by the enemy's cannon.

WEATHER, *rules for judging of*. 1. The rising of the mercury presages, in general, fair weather; and its falling foul weather, as rain, snow, high winds, and storms. When the surface of the mercury is convex, or stands higher in the middle than at the sides, it is a sign the mercury is then in a rising state; but if the surface be concave or hollow in the middle, it is then sinking. 2. In very hot weather, the falling of the mercury indicates thunder. 3. In winter, the rising presages frost; and in frosty weather, if the mercury falls three or four divisions, there will be a thaw; but in a continued frost, if the mercury rises, it will be cer-

tainly snow. 4. When foul weather happens soon after the depression of the mercury, expect but little of it; on the contrary, expect but little fair weather when it proves fair shortly after the mercury has risen. 5. In foul weather, when the mercury rises much and high, and so continues for two or three days before the bad weather is entirely over, then a continuance of fair weather may be expected. 6. In fair weather, when the mercury falls much and low, and thus continues for two or three days before the rain comes, then a deal of wet may be expected, and probably high winds. 7. The unsettled motion of the mercury denotes unsettled weather. 8. The words engraved on the scale are not so much to be attended to, as the rising and falling of the mercury; for, if it stand at much rain, and then rises to changeable, it denotes fair weather, though not to continue so long as if the mercury had risen higher. If the mercury stands at fair, and falls to changeable, bad weather may be expected. 9. In winter, spring, and autumn, the sudden falling of the mercury, and that for a large space, denotes high winds and storms; but in summer it presages heavy showers and often thunder. It always sinks lowest of all for great winds, though not accompanied with rain; but it falls more for wind and rain together, than for either of them alone. 10. If after rain the wind change into any part of the north, with a clear and dry sky, and the mercury rise, it is a certain sign of fair weather. 11. After very great storms of wind, when the mercury has been low, it commonly rises again very fast. In settled fair weather, except the barometer sink much, expect but little rain. In a wet season, the smallest depressions must be attended to; for when the air is much inclined to showers, a little sinking in the barometer denotes more rain. And in such a season, if it rise suddenly fast and high, fair weather cannot be expected to last more than a day or two. 12. The greatest heights of the mercury are found upon easterly and north-easterly winds; and it may often rain or snow, the wind being in these points, while the barometer is in a rising state, the effects of the wind counteracting. But the mercury sinks for wind as well as rain, in all other points of the compass.

WEAVING, the art of making threads into cloth. This art is of very ancient origin. The fabulous story of Penelope's web; and, still more, the frequent allusions to this art in the sacred writings, tend to show, that the constructing of cloth from threads, hair, &c. is a very ancient invention. It has, however, like other useful arts, undergone an infinite variety of improvements, both as to the materials of which cloth is made, the apparatus necessary in its construction, and the particular modes of operation by the artist. Weaving, when reduced to its original principle, is nothing more than the insertion of the weft into the web, by forming sheds; but this principle has been so extensively applied in almost every country, and the knowledge of its various branches has been derived from such a variety of sources, that no one person could ever be practically employed in all its branches; and though every part bears a strong analogy to the rest, yet a minute knowledge of each of these parts can only be acquired by experience and reflection. We will, however, endeavour to give the reader as comprehensive an idea of the history and progress of this ancient and invaluable art as the nature of the thing, and the limits to which we are necessarily confined will permit.

The history of this art is very little known, and its great antiquity necessarily involves the earlier æras of it in the most perfect obscurity. Enough, however, is known, to prove that none of the species of it originated in Britain. The silk manufacture was first practised in China, and the cotton in India. Both the woollen and linen were borrowed from the continent of Europe, and all improvements in them, in this country, were first introduced by foreign artificers who settled amongst us. To the present day, our superiority in point of quality is only universally acknowledged in the cotton manufacture; whilst in those of silk, woollen, and linen, it is still disputed by other countries. But it should be understood, that we are here speaking more particularly of the art in its more advanced and improved state. For, when it is considered, that as the wants of mankind are nearly the same in all countries, it is not improbable that the same arts, however varied in their operations, may have been invented in different countries. It is not, however, certain, that the art of making cloth is one which the Britons invented. It is more probable, that the Gauls learned it from the Greeks, and communicated the knowledge of it to the people of Britain. And it is certain that the inhabi-

tants of the southern parts of Britain were well acquainted with the arts of dressing, spinning and weaving, both flax and wool, when they were invaded by the Romans.

The art of making linen, which was probably the first species of cloth invented, was communicated by the Egyptians, the inhabitants of Palestine, and other eastern nations, to the Europeans. By slow degrees it found its way into Italy; and it afterwards prevailed in Spain, Gaul, Germany, and Britain. The Belgæ manufactured linen on the continent; and when they afterwards settled in this island, it is probable they continued the the practice, and taught it to the people among whom they resided.

Whatever knowledge the Britons might possess of the clothing arts, prior to the invasion, it is very certain that these arts were much improved amongst them after that event. It appears from the Notitia Imperii, that there was an imperial manufactory of woollen and linen cloth, for the use of the Roman army then in Britain, established at Venta Belgarum, now called Winchester.

In Bishop Aldhelm's book, concerning "Virginity," written about A. D. 680, it is remarked, "that chastity alone forms not a perfect character; but requires to be accompanied and beautified by other virtues." This observation is illustrated by the following simile, borrowed from the art of figure-weaving: "It is not a web of one uniform colour and texture, without any variety of figures, that pleaseth the eye, and appears beautiful; but one that is woven by shuttles, filled with threads of purple, and many other colours flying from side to side, and forming a variety of figures and images in different compartments with admirable art." Perhaps the most curious specimen of this ancient figure-weaving and embroidery, now to be found, is that preserved in the cathedral of Bayeaux. It is a piece of linen, about 19 inches in breadth, and 67 yards in length, and contains the history of the conquest of England, by William of Normandy; beginning with Harold's embassy, A. D. 1065, and ending with his death at the battle of Hastings, A. D. 1066. This curious work is supposed to have been executed by Matilda, wife to William, Duke of Normandy, afterwards King of England, and the ladies of her court.

Although it is certain that the art of figure-weaving was then known in Britain, it must be owned, that the piece of tapestry just mentioned owes most of its beauty to the exquisite needle-work with which it is adorned.

About the close of the eleventh century, the clothing arts had acquired a considerable degree of improvement in this island. About that time, the weavers in all the great towns were formed into guilds or corporations, and had various privileges bestowed upon them by royal charters. In the reign of Richard I. the woollen manufacture became the subject of legislation; and a law was made, A. D. 1197, for regulating the fabrication and sale of cloth. The number of weavers, however, was comparatively small, until the policy of the wise and liberal Edward III. encouraged the art, by the most advantageous offers of reward and encouragement to foreign cloth-workers and weavers who would come and settle in England. In the year 1331, two weavers came from Brabant, and settled at York. The superior skill and dexterity of these men, who communicated their knowledge to others, soon manifested itself in the improvement and spread of the art of weaving in this island.

Many weavers from Flanders were driven into England by the cruel persecutions of the duke of D'Alva, in the year 1567, who settled in different parts of the kingdom, and introduced, or promoted, the manufacture of baizes, serges, crapes, and other stuffs.

About the year 1686, nearly 50,000 manufacturers, of various descriptions, took refuge in Britain, in consequence of the revocation of the edict of Nantz, and other acts of religious persecution committed by Louis XIV. These improvements, &c. chiefly related to linen weaving.

The arts of spinning, throwing, and weaving silk, were brought into England about the middle of the fifteenth century, and were practised by a company of women in London, called silk-women. About A. D. 1480, men began to engage in the silk manufacture, and the art of silk-weaving, in England, soon arrived at very great perfection.

The civil dissentions which followed this period, retarded the progress of this art; but afterwards, when the nation was at rest, the arts of peace, and, among others, that of weaving, made rapid advances in almost every part of the kingdom. It has been generally supposed, that silk-weaving, particularly that of figure-weaving, has never been brought

to that perfection in England, to which it has attained in other countries. Our silk-weavers, however, seem at length determined to remove this reproach. For this purpose a most magnificent undertaking is at this time begun by the weavers in Spitalfields, London; the object of which is "to remove those prejudices which have long prevailed in favour of foreign manufactures." This object is intended to be accomplished by the "weaving of certain flags, for public exhibition, on which are to appear figures, flowers, and other devices," interwoven with various coloured silks.

After considerable labour and expense, this design is now begun to be put into execution, under the superintendance of a committee, who are appointed to receive subscriptions, and conduct the execution of the plans, &c. Mr. William Titford, of Union-street, Bishopsgate, has been appointed treasurer by the committee, and the undertaking is now making advances towards its final accomplishment. The weaving of the first flag is begun, and about twelve or fourteen inches of it completed. The designs for this flag are curious and well executed. They represent, within a large oval, "a female figure, with a dejected aspect, reclining on a remnant of brocade." Two figures, representing Enterprise and Genius, appear to encourage the dejected female. In the back ground is the Temple of Fame, on the top of which is a flag bearing the weaver's arms, to which Genius is directing the attention of the reclining figure. The four corners of this design, which are intended to be correctly engraved, are ornamented with appropriate emblematical figures of Peace, Industry, &c. It is two yards wide; and the figures in the body of the design are drawn nearly as large as life; but the silks, being all dyed fast colours, have not that brilliant appearance, in the work, which could have been wished. What makes this piece of work more curious, and will convey an extraordinary stability to its texture, is, that it has a satin ground, and is brocaded on both sides exactly alike. The threads of the web, or porry, are upwards of 48,900, the lead attached to the harness weighs upwards of 500 pounds, and the shuttles constantly in use, amount to upwards of 500. Two men are employed in the weaving, who are able to make, upon an average, about three-quarters of an inch daily.

The expense of this stupendous undertaking, with respect to the first flag only, will be not less than one thousand guineas. The admirers of art, and the friends of our national manufactures, will not think this information trifling or unnecessary; the correctness of which the writer of this article has been at considerable pains to ascertain: nor ought we to omit to mention, that the idea, and much of the design, of this piece of figure work, originated principally with Mr. Samuel Sholl, an ingenious silk-weaver, to whom the Society of Arts, a few years ago, gave a silver medal and thirty guineas, for the construction of an improved loom for weaving slight silks. For some account of the silk manufacture, see the article SILK.

The art of cotton-weaving, in its present improved state, has not been long known either in this or any other country. Wherever it originated, it is certain that most of our manufactures, in this respect, are unequalled in any part of the known world; and were it not for the many commercial restrictions, by which the present war is so unfortunately distinguished, there is every rational prospect that our cotton trade would be still further improved and extended.

Having briefly traced the history of this art in Great Britain, we proceed to a description of the manner in which it is practised in this country; confining our observations chiefly to the art of cotton weaving.

The apparatus necessary in the art of cloth-weaving consists, chiefly in the loom, shuttle, reed, and heddles, or harness, the form and use of which are here described.

There are several kinds of looms for cloth-weaving, the most common of which is that delineated on Plate Loom, (fig. 1 and 2) which represents the common silk-loom. In this plate, A, (fig. 1) is the yarn-beam; B, the cloth-beam, or breast-roll; D E, the treddles; *d d*, *e e*, the heddles, or harness: G, the lay, or batten; M, the seat-board; and T T, the rods. Fig. 2 is a view of the lay, or batten and reed; which, to shew the reed more distinctly, is represented without the lay-cape, being a long piece of wood, having a groove running along its lowermost side, for the purpose of sustaining the upper edge of the reed. The lay-cape is that part of the machine on the middle of which the weaver lays hold with his left hand when in the act of weaving. F, the lay-pole; G G, the lay-swords; H, the shuttle-race; I I, the boxes which receive the shuttles; *k k*

the peckers; *y*, the pecking-peg, or handle, and R, the reed.

When the weaver has received his warp from the warping-mill (for an account of which see MANUFACTURE *of Cotton*), his first care is to wind it upon the beam in a proper manner. Having ascertained the number of half-gangs, or beers, and the breadth of the web, he passes a small shaft of wood through the interval formed by the last of the lower pins upon the warping-mill, and a small cord tied to this shaft through that formed by the first. This gives him the lease for beaming, and keeps the half-gangs distinct. When this has been done, and the cord made fast at both ends of the shaft, the knotting left by the warper is cut, and the warp stretched to its proper breadth. An instrument, or utensil, called a ravel, is then to be used. Ravels are somewhat like reeds, and are also of different dimensions. One proper for the purpose being found, every half-gang is placed in an interval between two of the pins. The upper part, or cape, is then put on and secured, and the operation of winding the warp upon the beam commences. In broad works, two persons are employed to hold the ravel which serves to guide the warp, and to spread it regularly upon the beam; one or two to keep the chain, or chains of the warp, at a proper degree of tension, and one or more to turn the beam upon its centres. The warp being regularly wound upon the beam, the weaver prepares to take it through the heddles, and this operation is called drawing.

Before the operation of drawing commences, two rods are inserted into the lease formed by the upper-lease pins on the warping-mill; the ends of these rods are tied together, the twine by which the lease was secured is cut away, and the warp stretched to its proper breadth. The beam is then suspended by cords behind the heddles and somewhat higher, the warp hanging down perpendicularly. The weaver then places himself in front of the heddles, and another person is placed behind. The former opens every heddle in succession, and it is the business of the latter to select every thread in its order, and deliver it to be drawn through the open heddle. The succession in which the threads are to be delivered is easily ascertained by the rods, as every thread crosses that next to it. The warp, after passing through the heddles, is next drawn through the reed by an instrument called a sley, or reed-hook, two or more threads being taken through every interval.

These operations being finished, the cords or mounting which move the heddles are applied; the reed is placed in the lay, or batten, and the warp is divided into small portions, which are tied to a shaft connected by cords to the cloth beam.

When the weaver has finished these two operations of beaming and drawing, he proceeds to dress his warp. And here it should be remarked, that the operation of dressing applies principally to cotton. The same practice, when used upon silk, has a very destructive tendency; which is that of injuring the colours of the silk; and when used, as it sometimes very improperly is, by weavers of white satin, the injury done to the work is irreparable. In cotton, the operation of dressing is indispensable; in silk, this is by no means the case.

Dressing is justly esteemed of the first importance, in the art of weaving warps spun from flax or cotton; for it is impossible to produce work of a good quality, unless care be used in dressing the warp.

The use of dressing is, to give to yarn sufficient strength or tenacity, to enable it to bear the operation of weaving into cloth. It also, by laying smoothly all the ends of the fibres, which compose the raw material from which the yarn is spun, tends both to diminish the friction during the process, and to render the cloth smooth, and glossy, when finished. The substance in common use for dressing, is simply a mucilage of vegetable matter boiled to a consistency in water. Wheat flour, and sometimes potatoes, are the substances, commonly employed. These answer sufficiently well in giving to the yarn both the smoothness and tenacity required; but the great objection to them is, that they are too easily and rapidly affected by the operation of the atmosphere. When dressed yarn is allowed to stand exposed to the air, for any considerable portion of time, before being woven into cloth, it always becomes hard, brittle, and comparatively inflexible. It is then tedious and troublesome to weave, and the cloth is rough, wiry, and uneven. This effect is chiefly remarked in dry weather, when the weavers of fine cloth find it indispensably necessary to have their yarn wrought up, as speedily as possible, after being dressed. To counteract this inconveniency, herring or beef brine, and other saline substances, which have a tendency to attract moisture are sometimes mixed in small quantities with the dressing: but this has not proved completely and generally successful, probably, beause the proportions have not

been sufficienly attended to, and because a superabundance of moisture is equally prejudical with a deficiency. Indeed, the variation of the moisture of the air is so great and so frequent, that it has hitherto been impossible to fix any universal rule for the quantity to be mixed.

It is stated as a fact, which will appear singular to weavers in this country, that in India the process of weaving, even their finest muslins, is conducted in the open air, and exposed to all the heat of the climate, which is intense. (See MANUFACTURE *of Cotton.*) We know well that this would be impracticable with fine work in this country, even in an ordinary summer day. It is not known, in this country, what is the substance which the Indian weavers employ for dressing their warps. It certainly would prove of important benefit to our manufactures were this investigated in a satisfactory manner.

Neither does it appear that this subject, which is of much importance, has hitherto attracted the attention of scientific men, or that it has been treated in an accurate or philosophical manner. It, however, opens a wide field for chemical investigation, and promises to prove equally useful to mankind, and lucrative to the person who may succeed in supplying the desideratum.

When the warp, previously dressed, has been wrought up, as far as can be done conveniently, the weaver is obliged to suspend the operation of weaving, and to prepare a fresh quantity of warp. It is necessary to stop, when the dressed warp has approached within two or three inches of the back leaf of the heddles, that room may be allowed to join the old dressing to the new. The first operation, as in wool and silk, is to clear the warp, with the comb, from the lease rod to the yarn roll, or beam. The proof that this operation has been properly executed is, by bringing back the rods, successively, from their working situation to the roll. When this has been done, the two rods nearest to the heddles, are drawn out of the warp to one side, and the lease rod only remains. The next duty of the weaver is to examine the yarn about to be dressed, and carefully to take away every knot, lump, or other obstruction, which might impede the progress of the work, or injure the fabric of the cloth. In silk warps no further dressing is necessary; but in cotton warps the weaver proceeds to apply the substance used for dressing, which is rubbed gently, but completely, into the whole warp, by means of two brushes used in succession, one of which he holds in each hand. He then raises the lease rod, which in cotton weaving is a middle rod, on one edge to divide the warp, and sets the air in motion by moving a large fan, for the purpose of drying the warp which has been dressed. Fustian weavers use a large red-hot iron for this purpose. It is proper in this stage of the operation, to draw one of the dressing brushes lightly over the warp at intervals, in order to prevent any obstruction, which might arise by the threads, when agitated by the fan, cohering or sticking to each other, whilst in a wet state. Whenever the warp is sufficiently dried a very small quantity of grease is brushed over it, the lease rod is again placed upon its flat side, and cautiously shifted forward to the heddles. The other rods are then put again into their respective sheds, and the process is finished.

The first operation of dressing the warp being finished, the weaver begins that of forming the cloth. The operations required are only three, and these are very simple.

1st. Opening the sheds in the warp, alternately, by pressing the treddles with his feet.

2d. Driving the shuttle through each shed, when opened. This is performed by the right hand, when the fly-shuttle is used, and by the right and left hand, alternately, in the common operation.

3d. Pulling forward the lay, or batten, to strike home the woof, and again pushing it back nearly to the heddles. This is done by the left hand with the fly, and by each hand, successively, in the old way. See *Fly Shuttle*, in MANUFACTURE *of Cotton.*

In describing operations so simple and uniform, it is neither easy nor necessary to go much into detail.

By examining any piece of plain cloth, it will be found to be composed of two or more distinct sets of threads or filaments, running in opposite directions perpendicularly to each other; those threads (or, as some weavers call them, yarns) in the direction of the cloth's length are called the warp, and extend entirely from one end of the piece of cloth to the other The thread or yarn running across the cloth in an horizontal direction is called the woof, or weft. It is in fact one continued thread through the whole piece of cloth, being woven alternately over and under each yarn of the warp, until it arrives at the out side one. It then passes round the yarn, and returns back over

and under each thread as before; but in such a manner that it now goes over each yarn which it passed under before; thus firmly knitting or weaving the whole together. The outside yarn of the warp round which the woof is doubled, is called the selvage, and cannot be unraveled without breaking the woof. The breadth of the cloth determines the number of yarns the warp shall contain; and its quality limits their distances from each other and determines the fineness or set of the reed.

Though we have already generally explained the references to the plates, it will be necessary to be more minute in our description, in order to show the use to which the different parts of the apparatus are applied: *d d* are two sticks, connected together by several threads; which system of threads is called a heddle: *e e* is another heddle behind the former: in the middle of each thread composing the heddle is a loop, through which the yarns of the warp are passed; one half of them going through the loops of the heddle, *e e*, the other half of the yarns passing between the threads of the heddle, and afterwards through the eyes or loops of the other heddle *d d*. The two heddles, *d d* and *e e*, are connected together by two small cords going over pulleys suspended from the top of the loom, so that when one heddle is drawn down the other will be raised up. The heddles receive their motion from the levers, or treddles, D E, moved by the weaver's foot. The yarns of the warp are passed alternately through the loops of the heddles, so that by pressing down one treddle, as E, all the yarns belonging to the heddle, *e e*, are drawn down: and by means of the cords and pulleys, the other heddle, *d d*, with all the yarns belonging to it are raised up: leaving a space called the shed, of about two inches between the yarns. F G, G H (fig. 2) is a frame called the batten, or lay, suspended by the bar, F, from the upper rails of the loom, so that it can swing backwards and forwards. The bottom bar, H, is much broader than the rails, G G, and projects before their plane about an inch and a half, forming a shelf called the shuttle-race. The ends of the bar, H, have boards nailed on each side, and at the ends, to form two short troughs or boxes, I I, in which pieces of wood, or thick leather, *k k*, called peckers, or drivers, traverse: they are guided by two small wires, fixed at one end to the uprights, G G, and at the other to the end pieces of the troughs, I I. Each pecker has a string fastened to it tied to the handle, *y*, which the weaver holds in his right hand when at work, and with which he pulls each pecker, alternately, forward. R, is a small frame fixed upon the shuttle-race, H, formed of a number of small pieces of split reeds, or canes: or else of pieces of flat wire of steel or brass. This frame is called the reed. When this is in its place the yarns of the warp pass between the canes, or dents. The shuttle is a small piece of wood, pointed at each end, about six inches long. It has an oblong mortice in it, containing a small bobbin, on which is wound the weft, which runs through a small hole in the shuttle, called the eye. The shuttle has two little wheels on the under side, by which it runs upon the shuttle-race. H. See *Fly Shuttle*, in the article MANUFACTURE *of Cotton.*

The weaver sits on the seat M, (fig. 1) which hangs by pivots at its ends, that it may adapt itself to the ease of the weaver when he sits upon it. It is lifted out when the weaver gets into the loom, and he puts it in again after him. He leans lightly against the cloth roll, B, and places his feet upon the treddles, D E. In his right hand he holds the handle *y* (fig. 2) and by his left he lays hold of a bar, called the lay-cape, which crosses the batten, or lay, G G, and serves to support the upper edge of the reed, R. He commences the operation by pressing down one of the treddles with his foot: this depresses one half of the yarns of the warp, and raises the other, as before described: the shuttle is placed in one of the troughs, I, against the pecker, *k*, belonging to that trough: by drawing the handle of the pecker with a sudden jerk, he drives the pecker against the shuttle, and throws it across the warp upon the shuttle-race into the other trough, I, leaving the yarn of the woof which was wound on the bobbin after it. With his left he then pulls the lay towards him; by means of the reed, the yarn of the woof, which before was lying loose between the warp, is driven up towards the cloth roll: the weaver now presses down his other foot, which reverses the operation, pulling down the heddle which was up before, and raising that which before was depressed: by the other pecker he now throws the shuttle back again, leaving the woof after it between the yarns of the warp; and, by drawing up the batten, beats it close up to the thread before thrown. In this manner the operation is continued until a few inches are woven; it is then wound upon

the cloth roll, by putting a short lever into a hole made in the roll, and turning it round. A click, acting in the teeth of a serated wheel, prevents the return of the roll. The yarn roll, A (fig. 1,) has at each end a cord wound round it. One end of this cord is tied to the frame of the loom, the other has a weight hung to it: this rope causes a friction, which prevents its turning (unless the yarn is drawn by the cloth beam,) and always preserves a proper degree of tention in the yarn. T T (fig. 1) are two smooth sticks (cotton weavers have usually three) put between the yarns, to preserve the lease, and keep the threads, or yarns, from entangling. In cotton weaving, these sticks, or rods, are kept at an uniform distance from the heddles, either by tying them together, or by a small cord with a hook at one end, which lays hold of the front rod, and a weight at the other, which hangs over the yarn beam. The cloth is kept extended during the operation of weaving, by means of two pieces of hard wood, with small sharp points in their ends, which lay hold of the edges, or selvages, of the cloth. These pieces are connected by a cord, passing obliquely through holes, or notches, in each piece. By this cord they can be lengthened or shortened, according to the breadth of the web. They are kept flat after the cloth is stretched by a small bar turning on a centre fixed in one of the pieces, with its longer end projecting closely over the edge of the other piece. These pieces of wood, thus formed, are called the temples. Silk-weavers usually stretch their cloth by means of two small sharp-pointed hooks, fastened to the ends of two strings, with little weights at the other ends; and the strings are made to pass over little pulleys in each side of the loom, at a suitable distance from the selvages of the cloth.

In the treading of a web, most beginners are apt to apply the weight, or force, of the foot much too suddenly. The bad consequences attending this mistake are particularly felt in weaving fine or weak cotton yarn. In weaving, as in every other branch of mechanics, the resistance, or re-action, is always nearly as great as the moving power, or force, which it is necessary to apply. From this it follows, that the body of the warp must sustain a stress, nearly equal to the force with which the weaver's foot is applied to the treddle. Besides this, every individual thread is subjected to all the friction, occasioned by the heddles, and splits of the reed, between which the threads pass, and with which they are generally in contact when rising and sinking. But the art of spinning has not been as yet, and probably never can be, brought to such a degree of perfection, as to make every thread capable of bearing its proportion of this stress equally. It is confirmed both by mathematical demonstration, and by practical experience, that when any body is to be moved with increased velocity, it is necessary to exert greater powers to move it; and as the resistance increases in proportion to the power, this sudden application of the pressure of the foot to the treddle, must cause a proportional increase of the stress upon the warp, and also of the friction. Now, as it is impossible to make every thread equally strong, and equally tight, those which are the weakest, or the tightest, must bear much more than their equal proportion of the stress. This causes them to be broken very frequently, and, even with the greatest attention, more time is lost in tying and replacing them, than would have been sufficient for weaving a very considerable quantity into cloth. But when the weaver, from inattention, continues the operation after one or more threads are broken, the consequence is still worse. When a thread has been broken, it no longer retains its parallel situation to the rest, but crossing over or between those nearest to it, either breaks them also, or interrupts the passage of the shuttle: most frequently it does both.

In every kind of weaving, and especially in thin wiry fabrics, much of the beauty of the cloth depends upon the woof being well stretched. But if the motion of the shuttle be too rapid, it is very apt to recoil, and thus to slacken the thread. It has also a greater tendency either to break the woof altogether, or to unwind it from the pirn or bobbin, in doubles, which, if not picked out, destroy the regularity of the fabric. The woof of muslins and thin cotton goods is generally woven into the cloth in a wet state. This tends to lay the ends of the fibres of the cotton smooth and parallel, and its effect is similar to that of dressing of the warp. The person who winds the woof upon the pirn ought to be very careful that it be well built, so as to unwind freely. The best shape for those used in the fly-shuttle, in cotton weaving, is that of a cone; and the thread ought to traverse freely, in the form of a spiral or screw, during the operation of winding.

The same wheel, used for winding the warp upon bobbins, is also fit for winding the weft. It only requires a spindle of a different shape, with a screw at one end, upon which the pirn is fixed. The wheel is so constructed, that the spindles may be easily shifted, to adapt it for either purpose.

That the fabric of the cloth may be uniform in thickness, it is necessary that the lay, or batten, should be brought forward with the same force every time. In the common operation of weaving, this regularity must be acquired by practice. It is, however, of consequence to the weaver, to mount, or prepare, his loom in such a manner, that the range of the lay may be in proportion to the thickness of his cloth. As the lay swings, backward and forward, upon centres placed above, its motion is similar to that of a pendulum. Now the greater the arc, or range, through which the lay passes, the greater will be its effect, in driving home the weft strongly, and the thicker will be the fabric of the cloth, in so far as that depends upon the weft. For this reason, in weaving coarse and heavy goods, the heddles ought to be hung at a greater distance from the point where the weft is struck up, than would be proper in light work. The point, or rather line, where the last wrought shot of weft is struck up, is called by weavers the fell. The pivots, upon which the lay vibrates ought, in general, to be exactly at equal distances from a line drawn perpendicular to the fell, and one drawn perpendicular to the heddles, and between these two lines. But as the fell is constantly varying in its situation, during the operation, it will be proper to take the medium. This is the place where the fell will be, when a bore (*i. e.* as much as can be woven without drawing fresh yarn) is half wrought up. From this, the following conclusion may also be drawn: The bores ought always to be short in weaving light goods; for the less that the extremes vary from the medium, the more regular will be the arc, or swing, of the lay.

Having given a general outline of the nature and process of plain weaving, it is necessary, in order to convey to our readers a more comprehensive idea of the art, to notice the fanciful and ornamental parts of the business. The extent to which this species of manufacture is carried renders it an object of very great importance, and deserving a more minute description than our limits will admit.

Stripes are formed upon cloth, either by the warp or by the woof. When the former of these ways is practised, the variation of the process is chiefly the business of the warper: in the latter case it is that of the weaver. By unravelling any shred of striped cloth, it may easily be discovered, whether the stripes have been produced by the operations of the warper or those of the weaver.

Checks are produced by the combined operations of the warper and the weaver.

Tweeled cloths are so various in their textures, and at the same time so complicated in their formation, that it is impossible to convey an adequate idea of the mode of constructing them, without the aid of several engraved figures. In examining any piece of plain cloth, it will be observed, that all the threads in the warp and woof cross each other, and are tacked alternately. This is not the case in tweeled cloths; for in this instance only the third, fourth, fifth, sixth, &c. threads cross each other to form a texture. Tweeled cloths have been fabricated of various descriptions. In the coarsest kinds every third thread is crossed; in finer fabrics, they cross each other at intervals of four, five, six, seven, or eight threads, and in some very fine tweeled silks the crossing does not take place until the sixteenth interval.

Tweeling is produced by multiplying and varying the number of leases in the harness; by the use of a back-harness, or double harness; by increasing the number of threads in each split of the reed; by an endless variety of modes in drawing the yarns through the harness; and by increasing the number of treddles, and changing the manner of treading them. When the number of treddles requisite to raise all the variety of sheds necessary to produce very extensive patterns would be more than one man could manage, recourse is had to a mode of mounting, or preparing the loom, by the application of cords, &c. to the harness; and a second person is necessary to raise the sheds required, by pulling the strings attached to the respective leases of the back harness, which are sunk to their first position by means of leaden weights underneath. This is the most comprehensive apparatus used by weavers for fanciful patterns of great extent, and it is called the draw-loom. In weaving very fine silk tweels, such as those of sixteen leases, the number of threads drawn through each interval of the reed is so great, that, if woven with

a single reed, they would obstruct each other in rising and sinking, and the shed would not be sufficiently open to allow the shuttle a free passage. To avoid this inconvenience, other reeds are placed behind that which strikes up the weft; and the warp threads are so disposed, that those which pass through the same interval in the first reed are divided in passing through the second, and again in passing through the third. By these means the obstruction, if not entirely removed, is greatly lessened.

In the weaving of plain thick woollen cloths, to prevent obstructions of this kind, arising from the closeness of the set, and roughness of the threads, only one-fourth of the warp is sunk and raised by one treddle, and a second is pressed down to complete the shed, between the times when every shot of weft is thrown across.

Double cloth is composed of two webs, each of which consists of separate warp and separate weft; but the two are interwoven at intervals. The junction of the two webs is formed by passing each of them occasionally through the other, so that each particular part of both is sometimes above and sometimes below.

This species of weaving is almost exclusively confined to the manufacture of carpets in this country. The material employed is dyed woollen; and, as almost all carpets are decorated with fanciful ornaments, the colours of the two webs are different, and they are made to pass through each other at such intervals as will form the patterns required. Hence it arises, that the patterns of each side of the carpet are the same, but the colours are reversed. Carpets are usually woven in the draw-loom.

Gauze differs in its formation from other cloths, by having the threads of the warp crossed over each other, instead of lying parallel. They are turned to the right and left alternately; and each shot of weft preserves the twine which it has received. This effect is caused by a singular mode of producing the sheds, which cannot easily be described without the aid of drawings.

Cross, or *net-weaving*, is a separate branch of the art, and requires a loom particularly constructed for the purpose.

Spots, *Brocades*, and *Lappets*, are produced by a combination of the arts of plain, tweeled, and gauze weaving; and, as in every other branch of the art, are produced in all their varieties by different ways of forming the sheds, by the application of heddles, and their connections with the treddles which move them. Indeed, the whole knowledge of the art consists in this part of the apparatus of a loom.

In drawing up the foregoing account of the art of weaving, we have laboured under inconveniences of no small magnitude. The many different kinds of cloth; the almost infinite variety of ways, though all on the same general principle, of constructing them; the different formation of apparatus in making different cloths; and, lastly, the want of uniformity in the technical phraseology of the art, have all tended to render our descriptions far more intricate and difficult than they otherwise would have been. The assistance, however, which we have derived from the very excellent "Essays on the Art of Weaving," by Mr. Duncan, ought not to pass by us unacknowledged. It is a most curious and valuable publication, embracing almost every thing necessary to be known concerning the art on which it professes to treat.

WEBERA, in botany, a genus of the Pentandria Monogynia class and order. Essential character: contorted; berry inferior, two-celled, cells one-seeded; style elevated; stigma club-shaped; calyx five-cleft. There are three species.

WEDGE, one of the mechanical powers, as they are called. The wedge is a triangular prism, whose bases are equilateral acute-angled triangles. See MECHANICS.

WEEK, in chronology, a division of time comprising seven days. See CHRONOLOGY.

WEIGELIA, in botany, so named in honour of Christ. Ehrenfr. Weigel; a genus of the Pentandria Monogynia class and order. Essential character: calyx five-leaved; corolla funnel-form; style from the base of the germ; stigma peltate; seed one. There are two species, *viz.* W. japonica, and W. coræensis, both natives of Japan.

WEIGHT, in physics, is a quality in natural bodies, by which they tend towards the centre of the earth. See GRAVITATION. Weight may be distinguished into absolute, specific, and relative. It is demonstrated by Sir Isaac Newton: 1. That the weights of all bodies, at equal distances from the centre of the earth, are proportional to the quantities of matter that each contains. 2. On different parts at the earth's surface, the weight of the same body is different; owing to the spheroidal figure of the earth, which causes the bodies on the

surface to be nearer the centre in going from the equator towards the poles; and the increase of weight is nearly in proportion to the square of the sine of the latitude: the weight at the equator to that at the pole being as 229 : 230; or the whole increase of weight from the equator to the pole is the 229th part of the former. 3. That the weights of the same body, at different distances above the earth, are inversely as the squares of the distances from the centre. So that a body at the distance of the moon, which is 60 semi-diameters from the earth's centre, would weigh only $\frac{1}{3600}$th part of what it weighs at the surface of the earth. 4. That at different distances within the earth, or below the surface, the weights of the same body are directly as the distances from the earth's centre; so that at half way toward the centre a body would weigh but half as much, and at the centre it would weigh nothing at all. 5. A body immersed in a fluid, which is specifically lighter than itself, loses so much of its weight as is equal to the weight of a quantity of the fluid of the same bulk with itself. Hence a body loses more of its weight in a heavier fluid than in a lighter one, and therefore it weighs more in a lighter fluid than in a heavier one.

The weight of a cubic foot of water is 1000 ounces, or 62½*lb.* avoirdupois; this, multiplied by 32, gives 2000*lb.* the weight of a ton: hence eight cubic feet formerly made a hogshead, and four hogsheads a ton, in capacity as well as in weight. Measures for corn, coals, and other dry articles, were constructed on the same principle. A bushel of wheat, assumed as a general standard for all sorts of grain, weighed 62½*lb.* eight of these make a quarter, and four quarters, or 32 bushels, a ton weight. Coals were sold by the chaldron, and supposed to weigh a ton, though in reality it weighs much more. Hence a ton weight is the common standard for liquids, wheat, and coals. Had this analogy been adhered to, the confusion which is occasioned by different local weights would have been avoided.

To regulate the weights and measures of a country is a branch of the sovereign's prerogative. For the public convenience, these ought to be universally the same throughout the nation, the better to reduce the prices of articles to equivalent values. But as weight and measure are things in their nature arbitrary and uncertain, it is necessary that they be reduced to some fixed rule or standard. It is, however, impossible to fix such a standard by any written law or oral proclamation, as no person can, by words only, give to another an adequate idea of a pound weight, or foot rule. It is therefore expedient to have recourse to some visible, palpable, material standard, by forming a comparison with which all weights and measures may be reduced to one uniform size. Such a standard was anciently kept at Winchester; and we find in the laws of King Edgar, nearly a century before the conquest, an injunction that this measure should be observed throughout the realm.

Most nations have regulated the standard of measures of length from some parts of the human body: as the palm, the hand, the span, the foot, the cubit, the ell, (ulna, or arm) the pace, and the fathom. But as these are of different dimensions in men of different proportions, ancient historians inform us, that a new standard of length was fixed by our king Henry the First; who commanded that the ulna, or ancient ell, which answers to the modern yard, should be made of the exact length of his own arm. See MEASURE.

The standard of weights was originally taken from grains or corns of wheat, whence our lowest denomination of weights is still called a grain; thirty-two of which are directed, by the statute called "compositio mensurarum," to compose a penny-weight, twenty of which make an ounce, and twelve ounces a pound, &c. Under king Richard the First it was ordained, that there should be only one weight and one measure throughout the nation; and that the custody of the assize, or standard of weights and measures, should be committed to certain persons in every city and borough; from whence the ancient office of the king's ulnager seems to have been derived. These original standards were called pondus regis, and mensura domini regis, and are directed by a variety of subsequent statutes, to be kept in the exchequer chamber, by an officer called the clerk of the market, except the wine gallon, which is committed to the city of London, and kept in Guildhall. The Scottish standards are distributed among the oldest boroughs. The elward is kept at Edinburgh, the pint at Stirling, the pound at Lanark, and the firlot at Linlithgow.

The two principal weights established in Great Britain, are troy weight and avoirdupois weight, as before mentioned.

Under the head of the former it may further be added, that a carat is a weight of four grains; but when the term is applied to gold, it denotes the degree of fineness. Any quantity of gold is supposed divided into twenty-four parts. If the whole mass is pure gold, it is said to be twenty-four carats fine; if there are twenty-three parts of pure gold, and one part of alloy or base metal, it is said to be twenty-three carats fine, and so on. Pure gold is too soft to be used for coin. The standard coin of this kingdom is 22 carats fine. A pound of standard gold is coined into 44½ guineas, and therefore every guinea should weigh 5 dwts. $9\frac{39}{89}$ grains. A pound of silver for coin contains 11 oz. 2 dwts. pure silver, and 18 dwts. alloy; and standard silver plate 11 ounces pure silver, with one ounce alloy. A pound of standard silver is coined into 62 shillings, and therefore the weight of a shilling should be 3 dwts. $20\frac{28}{31}$ grains.

Under the words avoirdupois and troy will be found an account of those weights; here we may add a small table from Mr. Ferguson, which gives a more enlarged comparison between these two weights.

175 Troy pounds are equal to 144 avoirdupois pounds.
175 Troy ounces are equal to 192 avoirdupois ounces.
1 Troy pound contains 5760 grains.
1 Avoirdupois pound contains 7000 grains.
1 Avoirdupois ounce contains 437½ grains.
1 Avoirdupois dram contains 27.34375 grains.
1 Troy pound contains 13 *oz.* 2.651-428576 drams avoirdupois.
1 Avoirdupois *lb.* contains 1 *lb.* 2 *oz.* 11 *dwts.* 16 *grs.* troy.

Therefore the avoirdupois *lb.* is to the *lb.* troy as 175 to 144, and the avoirdupois *oz.* is to the troy *oz.* as 437½ is to 480.

The moneyers, jewellers, &c. have a particular class of weights for gold and precious stones, *viz.* carat and grain; and for silver, the penny-weight and grain. The moneyers have also a peculiar subdivision of the troy grain: thus, dividing

The grain into 20 mites,
The mite into 24 droits,
The droit into 20 periots,
The periot into 24 blanks.

The dealers in wool have likewise a particular set of weights: *viz.* the sack, weigh, tod, stone, and clove; the proportions of which are as below; *viz.*

The sack containing . . .	2 weighs,
The weigh	6½ tods,
The tod	2 stones,
The stone	2 cloves,
The clove	7 pounds.

But these weights differ in almost every country where dealings in wool are carried on largely.

Also 12 sacks make a last, or 4368 pounds.
Further,
56 *lb.* of old hay, or 60 *lb.* new hay, make a truss. See Truss.

In order to show the proportion of the several weights used throughout Europe, we shall add a reduction of them to one standard, *viz.* the London and Amsterdam pound.

1. Proportion of the weights of the principal places of Europe.

The 100 *lb.* of England, Scotland, and Ireland, are equal to

lb.	*oz.*	
91	8	of Amsterdam, Paris, &c.
96	8	of Antwerp or Brabant.
88	0	of Rouen, the viscounty weight.
106	0	of Lyons, the city weight.
90	9	of Rochelle.
107	11	of Toulouse and Upper Languedoc.
113	0	of Marseilles or Provence.
81	7	of Geneva.
93	5	of Hamburgh.
89	7	of Francfort, &c.
96	1	of Leipsick, &c.
137	4	of Genoa.
132	11	of Leghorn.
153	11	of Milan.
152	0	of Venice.
154	10	of Naples.
97	0	of Seville, Cadiz, &c.
104	13	of Portugal.
96	5	of Liege.
112	$\frac{2}{3}$	of Russia.
107	$\frac{1}{24}$	of Sweden.
89	½	of Denmark.

We shall now show the correspondence between English weights and some modern weights in France and other countries, which will be very useful in reading works on statistics and chemistry, as well modern as those that have been long published, and become standard books.

WEIGHTS.

ENGLISH WEIGHTS.

Troy Weight.

lb.	oz.	drms.	scruples.	grains.	grammes.
1 =	12 =	96 =	288 =	5760 =	372.96
	1 =	8 =	24 =	480 =	31.08
		1 =	3 =	60 =	3.885
			1 =	20 =	1.395
				1 =	0.06475

Avoirdupois Weight.

lb.	oz.	drms.	grains.	grammes.
1 =	16 =	256 =	7000	= 453.25
	1 =	16 =	437.5	= 28.32
		1 =	37.975	= 1.81

Correspondence of English weights with those used in France before the revolution.

The Paris pound, poids de marc of Charlemagne, contains 9216 Paris grains: it is divided into 16 ounces, each ounce into 8 gros, and each gros into 72 grains. It is equal to 7561 English troy grains.

The English troy pound of 12 ounces contains 5760 English troy grains, and is equal to 702 Paris grains.

The English avoirdupois pound of 16 ounces contains 7000 English troy grains, and is equal to 8538 Paris grains.

To reduce Paris grains to English troy grains, divide by
To reduce English troy grains to Paris grains, multiply by } 1.2189

To reduce Paris ounces to English troy, divide by............
To reduce Eng. troy ounces to Paris, multiply by.................. } 1.015734

Or the conversion may be made by means of the following tables.

1. *To reduce French to English troy weight.*

The Paris pound	= 7561	English troy grains.
The ounce	= 472.5624	
The gros	= 59.0703	
The grain	= .8204	

2. *To reduce English troy to Paris weight.*

The Eng. troy pound of 12 ounces . . .	= 7021.	Paris grains.
The troy ounce	= 585.0893	
The dram of 60 grains	= 73.1354	
The pennyweight, or denier, of 24 grains	= 29.2541	
The scruple of 20 grs.	= 24.3784	
The grain	= 1.2189	

3. *To reduce Eng. avoird. to Paris weight.*

The avoirdupois pound of 16 ounces, or 7000 troy grains	= 8538.	Paris grs.
The ounce	= 533.6250	

TABLE,

Showing the comparison between French and English grains. (Poid de Marc.)

French grs.	= Eng. grs.	Eng. grs.	= French grs.
1	0.8203	1	1.2189
2	1.6407	2	2.4378
3	2.4611	3	3.6568
4	3.2815	4	4.8757
5	4.1019	5	6.0947
6	4.9223	6	7.3136
7	5.7427	7	8.5325
8	6.5631	8	9.7515
9	7.3835	9	10.9704
10	8.203	10	12.189
20	16.407	20	24.378
30	24.611	30	36.568
40	32.815	40	48.757
50	41.019	50	60.947
60	49.223	60	73.136
70	57.427	70	85.325
80	65.631	80	97.513
90	73.835	90	109.704
100	82.03	100	121.89
200	164.07	200	243.78
300	246.11	300	365.68
400	328.15	400	487.57
500	410.19	500	609.47
600	492.23	600	731.36
700	574.27	700	853.25
800	656.31	800	975.15
900	738.35	900	1097.04
1000	820.3	1000	1218.9
2000	1640.7	2000	2437.8
3000	2461.1	3000	3656.8
4000	3281.5	4000	4875.7
5000	4101.9	5000	6094.7
6000	4922.3	6000	7313.6
7000	5742.7	7000	8532.5
8000	6563.1	8000	9751.5
9000	7383.5	9000	10970.4
10,000	8233.0	10,000	12189.0

GERMAN.

71 *lbs.* or grs. English troy = 74 *lbs.* or grs. German apothecaries weight.

1 oz. Nuremberg medic. weight = 7 dr. 2 sc. 9 grains English.

1 mark Cologne = 7 oz. 2 dwt. 4 gr. English troy.

DUTCH.

1 *lb.* Dutch = 1 *lb.* 3 oz. 16 dwt. 7 gr. English troy.

787½ *lbs.* Dutch = 1038 *lbs.* English troy.

SWEDISH WEIGHTS,

Used by Bergman and Scheele.

The Swedish pound, which is divided like the English apothecary, or troy pound, weighs 6556 grains troy.

The kanne of pure water, according to Bergman, weighs 42250 Swedish grains, and occupies 100 Swedish cubical inches. Hence the kanne of pure water weighs 48088.719444 English troy grains, or is equal to 189.9413 English cubic inches; and the Swedish longitudinal inch is equal to 1.238435 English longitudinal inches.

From these data, the following rules are deduced:

1. To reduce Swedish longitudinal inches to English, multiply by 1.2384, or divide by 0.80747.

2. To reduce Swedish to English cubical inches, multiply by 1.9, or divide by 0.5265.

3. To reduce the Swedish pound, ounce, dram, scruple, or grain, to the corresponding English troy denomination, multiply by 1.1382, or divide by 8.786.

4. To reduce Swedish kannes to English wine pints, multiply by .1520207, or divide by 6.57804.

5. The lod, a weight sometimes used by Bergman, is the 32d part of the Swedish pound: therefore, to reduce it to the English troy pound, multiply by .03557, or divide by 28.1156.

Universal Standard for Weights and Measures.

This is an object of vast importance, could it be attained: we fear, however, that, like a project for universal peace and good-will among men, it is a thing rather to be desired than expected, in the present state of things. Philosophers may speculate on the importance and excellence of such a scheme, but statesmen busy in projects of ambition, have not leisure to attend to any thing that does not augment their power, extend their influence, and render them rather a terror to mankind, than the objects of their praise and veneration. It behoves us, however, to give, in few words, a sketch of what has been attempted with a view to an universal standard for weights and measures through the whole world. The plans laid down have been deduced from philosophical principles. After the invention of pendulum clocks, it occurred that the length of a pendulum which should vibrate seconds, would be proper to be made a universal standard for length, whatever the denomination should be fixed on, whether yard, or any thing else. It was however found, that it would be difficult in practice to measure and determine the true length of such a pendulum, that is, the exact distance between the point of suspension and the point of oscillation. Another cause of inaccuracy was afterwards discovered, when it was found that the second's pendulum was of different lengths in all the different latitudes, owing to the spheroidal figure of the earth, (see EARTH,) which is the cause why places, in different latitudes, at different distances from the centre, and of course the pendulums, are acted upon by different forces of gravity, and therefore require to be of different lengths. In the latitude of London this is found to be $39\frac{1}{8}$ inches nearly.

The Society of Arts, &c. have offered premiums for a plan that might accomplish this great object: and among other devices then brought forward was one by Mr. Hatton, which consisted in measuring the difference of the lengths of two pendulums at different times of vibration, which could be performed more easily and accurately than that of the length of one single pendulum. This method was put in practice, and fully explained and illustrated by the late Mr. Whitehurst, in his attempts to ascertain an universal standard of weights and measures. The same kind of inaccuracy of measurement obtains in this way, though in a smaller degree, as in a single pendulum. Another method has been proposed, on observing very accurately the space that a heavy body falls freely through in one second of time. Here absolute accuracy is almost unattainable; besides, the form of the earth introduces difficulties, owing to the different distances from the centre, and the consequent diversity in the force of gravity by which the body falls. This space, in the latitude of London, has been found 193 inches, of course it is different in other latitudes. The method of late years, proposed by the French, is that of measuring a degree on the earth's surface, at the latitude of 45 degrees, and from this to deduce an universal measure of lengths, which would be easily applicable to weights also.

WEIGHTS and MEASURES, in law. The standard of measures was originally kept at Winchester, which measure was, by the law of King Edgar, ordained to be

observed throughout the kingdom. By statute 35 George III. c. 102, the justices in quarter sessions, in every county, are required to appoint persons to examine the weights and balances within their respective jurisdictions. These inspectors may seize and examine weights in shops, &c. and seize false weights and balances; and the offender, being convicted before one justice, shall be fined from five shillings to twenty shillings. Persons obstructing the inspectors, to forfeit from five shillings to forty shillings. Inspectors to be recompensed out of the county rate. Standard weights to be purchased by the sessions out of the county rate, and produced to all persons paying for the production thereof. Informations to be within one month.

WEINMANNIA, in botany, so named in honour of Joh. Wilh. Weinmann; a genus of the Octandria Digynia class and order. Natural order of Saxifragæ, Jussieu. Essential character: calyx four-leaved; corolla four-petalled; capsule two-celled, two-beaked. There are six species.

WELDING. Welding is that intimate union produced between the surfaces of two pieces of malleable metal, when heated almost to fusion and hammered. This union is so strong, that when two bars of metal are properly welded, the place of junction is as strong, relatively to its thickness, as any other part of the bar. Only two of the old metals are capable of firm union by welding, namely platina and iron; the same property belongs to the newly discovered metals, potassium and sodaum.

WERNERITE, in mineralogy, is of a colour between yellow and green; it occurs crystallized; specific gravity is about 3.6. It intumesces before the blow-pipe, and melts into a whitish enamel. It is found in the iron mines in Sweden and Norway.

WESTRINGIA, in botany, so named in honour of John Peter Westring; a genus of the Didynamia Gymnospermia class and order. Natural order of Verticillatæ. Labiatæ, Jussieu. Essential character: calyx half, five-cleft, five-sided; corolla reversed, with four segments, the longest erect, cloven; stamens distant, the two shorter, or lowest, abortive. There is only one species, *viz.* W. rosmariniformis, a native of New South Wales, near Port Jackson.

WHALE. See BALÆNA.

WHALE *fishery*. See FISHERY.

WHARF, a space on the banks of a haven, creek, or hithe, provided for the convenient loading and unloading of vessels upon. The fee paid for the landing of goods on a wharf, or for shipping them off, is called wharfage; and the person who has the direction and oversight of the wharf, receives wharfage, &c. is called the wharfinger.

WHEAT. See TRITICUM.

WHEEL. This is one of the six powers of mechanism; and without doubt, contributes more than any of the other five to the general convenience of mankind, by the wonderful variety of purposes, from a mill to a watch, wherein it is employed. It is our intention, however, in this place, to confine ourselves to the wheel as appertaining to vehicles in general, referring the readers to the articles MILL *work*, WATCH *work*, CLOCK *work*, &c. for the application of such wheels as come within those branches of the arts.

Of carriage wheels, in general, we shall then treat; observing, that any attempt to prove that a carriage is more easily drawn upon wheels than upon sledges, would be an affront to the understanding of the reader. But whether high, or low, wheels are fitted for the purpose, has been a sudject of dispute, even among persons of skill. Reason and experience, however, seem perfectly to agree in this, that wheels, whose centres are on a level with the moving power, will be easiest drawn along a level plane; and that the higher a wheel is the more easily will it get over the obstacles it may meet with, provided the moving power be not below the centre. It seems to follow, therefore, that carriages drawn by horses, or oxen, should have wheels whose centres have the height of the draft line; that is, of the shoulders of the horses, or the yokes of the oxen. This is true, however, only in the case of a horizontal road; in going up hill the distance of the line of draught from the road is somewhat less; because, when a man, or any other animal, is standing upon the side of a slope, his height is inclined to that slope; or rather the slope is inclined towards him, where he stands perfectly perpendicular. This being the situation in which cattle labour most, it is necessary to proportion the draft, so as to render it as light as possible while drawing up hill; therefore, it is usual, and highly proper so to proportion the height of the axle, especially in carts with two wheels, to the point of draught, that the line drawn from the centre of the wheel to that point should rise at an angle of about twelve or fourteen degrees; thus, when the horse is labouring up hill he will

come nearly to a level with the wheel's centre, and draw to the greatest advantage. This may serve as a general rule; but where local circumstances prevail of a different tendency, and also in particular cases, the height of the wheels must be suited to meet such. We reckon that in ordinary work, and where the horses do not exceed the height of fifteen hands and a half, the wheels should be from four feet eight inches to five feet two. Yet the immense loads drawn in the coal carts at Glasgow, on wheels more than six feet high, and other instances of a like kind, prove that very great powers are gained by using high wheels; under due construction and application the difference of the wheel's weight will not prove any material drawback. In ascending, high wheels will be found to facilitate the draught in exact ratio with the squares of their diameters; but in descending they are liable to press in the same proportion. An admirable device was produced by Lord Somerville, for throwing the weight behind the centre in going down hill, by cocking the fore-part of the body of a cart; so that while the shaft may incline downwards, in proportion to the line of declivity, the bottom of the cart's body should remain horizontal; this construction is now common in Devonshire, Somersetshire, &c.

Wheels are commonly made with what is called a dish; that is, the spokes are set at an angle into the nave, or centre-piece; so that, when the interior end of the nave is placed on the ground, the wheel may appear to be dished, or hollow, in the centre. Experience has shown, that when wheels have been made cylindrical, and not with the conical hollow just described, so that the spokes stood at right angles with the centre of the axle, numberless inconveniences arose; the dirt taken up by the wheel used to fall in between the nave and the axle, so as to choak and wear it considerably. Such wheels also required to stand wider apart, and demanded greater road way; besides they were very apt to be wrenched when pressed by any exterior resistance, and the spokes were forced back in the mortices. According to the present plan of dishing wheels, usually to about four inches in five feet of diameter, the exterior resistances are avoided; the axle being so turned down at its ends, as to cause the lower spoke, which bears up the load, to stand perpendicularly under the centre; thus occasioning the upper parts of the two wheels on the same angle to spread from each other; while the lower parts converge in the same proportion. Cylindrical wheels, that is, such as are not dished, would answer, provided the carriage were always on a perfectly horizontal plane; but they would subject the nave to be loaded with mud, and pinch the load, when consisting of light articles rising above the body of the carriage.

The spokes should be set so far from the outer end of the nave, that a perpendicular from the sole to the under side of the axle may fall, between an inch and two inches, between the bushes. By this, the pressure will be somewhat greater on the outer than on the inward bush, when the wheels are on a level. This ought to be so; for the inner part of the axle arm being much bigger than the outer, it has more friction, therefore should have less pressure; besides, every sinking of the wheel, more than the other, causes it to pinch the inner bush. The best mode of placing spokes in the naves, is to mortice them in two rows, alternately; this does not weaken the centre so much as when all the spokes are in one row, or band, and gives a greater degree of resistance outwards. The tire, or iron binding of a wheel, must be so laid on, whether in one or more bands, as to form the frustrum of a cone; but in heavy waggons it is usual to make the middle of the tire rise considerably, so as to bear the whole weight on hard roads, whereby the carriage will move lighter than if the frustrum were rectilinear; this form likewise causes stones, &c. to slip aside; but in soft soils it is apt to occasion much sinking. The axle arm should be taper, in order that it may give the wheel rather a disposition to slide off; otherwise it would be apt to close inwardly, and create excessive friction; hence the necessity for good iron wasters exteriorly, and substantial linch-pins. There is a common practice of setting the wheels forward; that is, giving them a slight inclination towards each other, whereby they are perhaps an inch nearer at their front than at their backs; this is done to make the wheel run more even on its sole, or bearing part, and to prevent its gaping forward; but it is evidently a distortion, which prevents the wheel from running exactly at right angles with the transverse section of the carriage. The nave of a heavy wheel, that is, for our ordinary cart for field purposes, need not be more than twelve or fourteen inches in length; if too short, the wheel will wabble, unless fitted very tight on the axle; while too

long a nave is apt to catch the dirt from the upper part, and to project too much beyond the outer face of the fellies; the above length is exclusive of the pan at the outer end.

The proportions of wheels must be estimated according to the purposes to which they are to be applied; thus waggons have in general large hind-wheels, while in timber carriages the four are usually of the same height, or nearly so; the London common stage carts have large wheels, while the drays used by brewers have very low ones. The reason is obvious; waggons and carts load behind; but timber carriages and drays load at the sides; therefore, in such, large wheels, however much they might favour the draught, would be extremely inconvenient; indeed incompatible. Wheels, whatever their size, should be made of well-seasoned tough wood, perfectly free from blemish; the naves are generally of elm, the spokes of oak, and the fellies of elm or of ash: such are found to answer best for all carriages attached to the ordnance department; in which the following are considered as the regular standard heights.

All the horse-artillery carriages, limbers, and waggons; the heavy six-pounders, and long three-pounders, and their limbers; the carriage of a six-pounder battalion gun; of a light five and a half inch howitzer; and the hind wheels of an ammunition waggon, five feet. The limber to a light six-pounder, and five and a half inch howitzer; the carriage of a medium twelve-pounder, four feet eight inches. The limber of the latter four feet six inches. A sling-cart, five feet eight inches. The fore-wheels of an ammunition waggon, four feet. A pontoon carriage has the fore-wheels three feet, and the hind ones five feet six inches. The carriage of an eight inch howitzer, five feet; the limber, four feet. A ball ammunition cart, five feet.

We are disposed to recommend these proportions to the consideration of readers concerned in the construction, or in the use of wheel carriages; they being the result of innumerable experiments, submitted to unequivocal proof under every variety of locality and of burthen. We tnink it necessary, at the same time, to observe, that a correspondent of the Agricultural Magazine, formerly published by Longman, Hurst, Rees, and Orme, of Paternoster-row, has, in the eleventh number of that work, given, what appears to be, an excellent rule for the proportions of wheels in waggons. It would not be admissable for us to give the whole of the reasonings of that correspondent, as contained in various numbers; but from that which we have particularized, we have the pleasure to furnish the following extract; or, at least, the sense of it.

"If the fore-wheel be four feet four inches in height, and the line of traction (draught) be drawn at an elevation of twelve degrees from the centre of its axle, the point where that line cuts the circumference of the wheel in its front gives that height from the plane on which the carriage stands, that will determine the radius of the hinder wheel. In this instance, the hind-wheel would have a radius of two feet nine inches, giving of course five feet six inches for its diameter."

A view of the plate given in that work, not only will illustrate the above explanation, but will satisfy a person respecting the justness of the proportions above detailed; when tempered by the following cautions, we consider the instruction given to be admirable. "The fore-wheel ought to be as nearly level with the point of draught, that is, where the shaft is suspended by the gear, as may be convenient; observing, that an angle of twelve degrees is to be given, on account of the difference between the horse's height as he stands at rest, and the real altitude of the point of draught from the ground, when he is in a state of exertion. During great efforts, horses lose very considerably of their standard, and thus bring the shaft to nearly a parallel with the plane on which they move. Attention must be paid to keeping the wheel within such limits as may not trespass on other matters, often of more consequence even than ease of draught; loading, turning, weight, expense, &c. must always form a part of the calculation."

Wheel *work*. Of all the modes of communicating motion, the most extensively useful is the employment of wheel-work, which is capable of varying its direction and its velocity without any limit.

Wheels are sometimes turned by simple contact with each other; sometimes by the intervention of cords, straps, or chains, passing over them; and in these cases the minute protuberance of the surfaces, or whatever else may be the cause of friction, prevents their sliding on each other. Where a broad strap runs on a wheel, it is usually confined to its situation, not by causing the margin of the wheel to project, but, on the con-

trary, by making the middle prominent; the reason of this may be understood by examining the manner in which a tight strap running on a cone would tend to run towards its thickest part. Sometimes also pins are fixed in the wheels, and admitted into perforations in the straps; a mode only practicable where the motion is slow and steady. A smooth motion may also be obtained, with considerable force, by forming the surfaces of the wheels into brushes of hair. More commonly, however, the circumferences of the contiguous wheels are formed into teeth, impelling each other, as with the extremities of so many levers, either exactly or nearly in the common direction of the circumferences; and sometimes an endless screw is substituted for one of the wheels. In forming the teeth of wheels, it is of consequence to determine the curvature which will procure an equable communication of motion, with the least possible friction. For the equable communication of motion, two methods have been recommended; one, that the lower part of the face of each tooth should be a straight line in the direction of the radius, and the upper a portion of an epicycloid, that is, of a curve described by a point of a circle rolling on the wheel, of which the diameter must be half that of the opposite wheel; and in this case it is demonstrable, that the plane surface of each tooth will act on the curved surface of the opposite tooth, so as to produce an equable angular motion in both wheels; the other method is, to form all the surfaces into portions of the involutes of circles, or the curves described by a point of thread which has been wound round the wheel, while it is uncoiled; and this method appears to answer the purpose in an easier and simpler manner than the former. It may be experimentally demonstrated, that an equable motion is produced by the action of these curves on each other; if we cut two boards into forms terminated by them, divide the surfaces by lines into equal or proportional angular portions, and fix them on any two centres, we shall find, that as they revolve, whatever parts of the surfaces may be in contact, the corresponding lines will always meet each other.

Both these methods may be derived from the general principle, that the teeth of the one wheel must be of such a form, that their outline may be described by the revolution of a curve upon a given circle, while the outline of the teeth of the other wheel is described by the same curve revolving within the circle. It has been supposed by some of the best authors, that the epicycloidal tooth has also the advantage of completely avoiding friction; this is however by no means true, and it is even impracticable to invent any form for the teeth of a wheel, which will enable them to act on other teeth without friction. In order to diminish it as much as possible, the teeth must be as small and as numerous as is consistent with strength and durability; for the effect of friction always increases with the distance of the point of contact from the line joining the centres of the wheels. In calculating the quantity of the friction, the velocity with which the parts slide over each other has generally been taken for its measure. This is a slight inaccuracy of conception, for it is certain, that the actual resistance is not at all increased by increasing the relative velocity; but the effect of that resistance, in retarding the motion of the wheels, may be shown, from the general laws of mechanics, to be proportional to the relative velocity thus ascertained. When it is possible to make one wheel act on teeth fixed in the concave surface of another, the friction may be thus diminished in the proportion of the difference of the diameters to their sum. If the face of the teeth, where they are in contact, is too much inclined to the radius, their mutual friction is not much affected, but a great pressure on their axis is produced; and this occasions a strain on the machinery, as well as an increase of the friction on the axis. If it is desired to produce a great angular velocity with the smallest possible quantity of wheel-work, the diameter of each wheel must be between three and four times as great as that of the pinion on which it acts. Where the pinion impels the wheel, it is sometimes made with three or four teeth only; but it is much better in general to have at least six or eight; and considering the additional labour of increasing the number of wheels, it may be advisable to allot more teeth to each of them than the number resulting from the calculation; so that we may allow thirty or forty teeth to a wheel acting on a pinion of six or eight. In works which do not require a great degree of strength, the wheels have sometimes a much greater number of teeth than this; and on the other hand, an endless screw or a spiral acts as a pinion of one tooth, since it propels the wheel through the breadth of one tooth

only in each revolution. For a pinion of six teeth, it would be better to have a wheel of thirty-five or thirty-seven than thirty-six; for each tooth of the wheel would thus act in turn upon each tooth of the pinion, and the work would be more equally worn than if the same teeth continued to meet in each revolution. The teeth of the pinion should also be somewhat stronger than those of the wheel, in order to support the more frequent recurrence of friction. Is has been proposed, for the coarser kinds of wheel-work, to divide the distance between the middle points of two adjoining teeth into thirty parts, and to allot sixteen to the tooth of the pinion, and thirteen to that of the wheel, allowing one for freedom of motion.

The wheel and pinion may either be situated in the same plane, both being commonly of the kind denominated spur-wheels, or their planes may form an angle; in this case one of them may be a crown or contrate wheel; or both of them may be bevelled, the teeth being cut obliquely. According to the relative magnitude of the wheels, the angle of the bevel must be different, so that the velocities of the wheels may be in the same proportion at both ends of their oblique faces; for this purpose, the faces of all the teeth must be directed to the point where the axes would meet. In cases where a motion not quite equable is required, as it sometimes happens in the construction of clocks, but more frequently in orreries, the wheels may either be divided a little unequally, or the axis may be placed a little out of the centre; and these eccentric wheels may either act on other eccentric wheels, or, if they are made as contrate wheels, upon a lengthened pinion. An arrangement is sometimes made for separating wheels which are intended to turn each other, and for replacing them at pleasure; the wheels are said to be thrown by these operations out of gear and into gear again. When a wheel revolves round another, and is so fixed as to remain nearly in a parallel direction, and to cause the central wheel to turn round its axis, the apparatus is called a sun and planet wheel. In this case, the circumference of the central wheel moves as fast as that of the revolving wheel, each point of which describes a circle equal in diameter to the distance of the centres of the two wheels; consequently, when the wheels are equal, the central wheel makes two revolutions, every time that the exterior wheel travels round it. If the central wheel be fixed, and the exterior wheel be caused to turn on its own centre during its revolution, by the effect of the contact of the teeth, it will make in every revolution one turn more, with respect to the surrounding objects, than it would make, if its centre were at rest, during one turn of the wheel which is fixed; and this circumstance must be recollected when such wheels are employed in planetariums.

Wheels are usnally made of wood, of iron, either cast or wrought, of steel, or of brass. The teeth of wheels of metal are generally cut by means of a machine; the wheel is fixed on an axis, which also carries a plate furnished with a variety of circles, divided into different numbers of equal parts, marked by small excavations; these are brought in succession under the point of a spring, which holds the axis firm, while the intervals between the teeth are expeditiously cut out by a revolving saw of steel. The teeth are afterwards finished by a file; and a machine has also been invented for holding and working the file. It is frequently necessary in machinery to protract the time of application of a given force, or to reserve a part of it for future use. This is generally effected by suffering a weight to descend, which has been previously raised, or a spring to unbend itself from a state of forcible flexure, as is exemplified in the weights and springs of clocks and watches. The common kitchen jack is also employed for protracting and equalizing the operation of a weight; in the patent jack the same effect is produced by an alternate motion, the axis being impelled backwards and forwards, as in clocks and watches, by means of an escapement, and the place of a balance spring being supplied by the twisting and untwisting of a cord.

In these machines, as well as in many others of greater magnitude, the fly wheel is a very important part, its velocity being increased by the operation of any part of the force which happens to be superfluous, and its rotatory power serving to continue the motion when the force is diminished or withdrawn. Thus, when a man turns a winch, he can exert twice as much force in some positions as in others, and a fly enables him in some cases to do nearly one-third more work. In the pile engine, also, without the help of the fly, the horses would fall for want of a counterpoise, as soon as the weight is disengaged. Such a fly ought

to be heavy, and its motion must not be too rapid, otherwise the resistance of the air will destroy too much of the motion; but in the kitchen jack, as well as in the striking part of a clock, where the superfluous force is purposely destroyed, the fly is made light, and strikes the air with a broad surface. An effect similar to that of a fly and a spring is sometimes produced in hydraulic machines by the introduction of an air vessel, the air contained in which is compressed more or less according to the intensity of the force, and exerts a more uniform pressure in expelling the fluid which is forced irregularly into it. See Young's Lectures.

WHEEL, in the military art, is the word of command, when a battalion or squadron is to alter its front either one way or the other. To wheel to the right, directs the man in the right angle to turn very slowly, and every one to wheel from the left to the right, regarding him as their centre; and *vice versa* when they are to wheel to the left. When a division of men are on the march, if the word be to wheel to the right or to the left, then the right or left hand man keeps his ground, only turning on his heel, and the rest of the rank move about quick till they make an even line with the said right or left hand man.

WHEELS, *water*. See MILL.

WHIRLWIND, a wind that rises suddenly, is exceedingly rapid and impetuous, in a whirling direction, and often progressively also; but it is commonly soon spent. Dr. Franklin, in his Physical and Meteorological Observations, read to the Royal Society in 1756, supposes a whirlwind and a water-spout to proceed from the same cause: their only difference being, that the latter passes over the water, and the former over the land. This opinion is corroborated by the observations of many others, who have remarked the appearances and effects of both to be the same. They have both a progressive as well as a circular motion; they usually rise after calms and great heats, and mostly happen in the warmer latitudes: the wind blows every way from a large surrounding space, both to the water-spout and whirlwind; and a water-spout has, by its progressive motion, passed from the sea to the land, and produced all the phenomena and effects of a whirlwind; so that there is no reason to doubt that they are meteors arising from the same general cause, and explicable upon the same principles, furnished by electrical experiments and discoveries.

WHISPERING *places*, are places where a whisper, or other small noise, may be heard from one part to another, to a great distance. They depend on a principle, that the voice, &c. being applied to one end of an arch, easily passes by repeated reflections to the other.

Hence sound is conveyed from one side of a whispering gallery to the opposite one, without being perceived by those who stand in the middle. The form of a whispering gallery is that of a segment of a sphere, or the like arched figure; and the progress of the sound through it may be illustrated in the following manner: Let A B C (Plate XVI. Miscel. fig. 12.) represent the segment of a sphere; and suppose a low voice uttered at A, the vibrations extending themselves every way, some of them will impinge upon the points E, E, &c.; and thence be reflected to the points F, F, &c.; thence to G, G, &c.; till at last they meet in C; where, by their union, they cause a much stronger sound than in any part of the segment whatever, even at A, the point from whence they came. Accordingly, all the contrivance in whispering places is, that near the person who whispers there may be a smooth wall, arched either cylindrically or elliptically. A circular arch will do, but not so well.

The most considerable whispering-places in England are, the whispering-gallery in the dome of St. Paul's, London, where the ticking of a watch may be heard from side to side, and a very easy whisper be sent all round the dome. The famous whispering-place in Gloucester Cathedral is no other than a gallery above the east end of the choir, leading from one side thereof to the other. It consists of five angles and six sides, the middlemost of which is a naked window, yet two whisperers hear each other at the distance of twenty-five yards.

WHISTON, (WILLIAM), an English divine, philosopher, and mathematician, of uncommon parts, learning, and extraordinary character, was born the 9th of December 1667, at Norton in the county of Leicester, where his father was rector. He was educated under his father till he was seventeen years of age, when he was sent to Tamworth school, and two years after admitted of Clare-hall, Cambridge, where he pursued his studies, and particularly the mathematics, with great diligence.

In 1693, he was made Master of Arts, and Fellow of the College, and soon after commenced one of the tutors; but his ill state of health soon after obliged him to relinquish this profession. Having entered into orders, in 1694, he became chaplain to Dr. More, Bishop of Norwich; and while in this station he published his first work, entitled "A New Theory of the Earth, &c." in which he undertook to prove that the Mosaic doctrine of the earth was perfectly agreeable to reason and philosophy; which work, having much ingenuity, brought considerable reputation to the author.

In the year 1698, Bishop More gave him the living of Lowestoff in Suffolk, where he immediately went to reside, and devoted himself with great diligence to the discharge of that trust. In the beginning of the last century he was made Sir Isaac Newton's deputy, and afterwards his successor in the Lucasian professorship of mathematics, when he resigned his living at Lowestoff, and went to reside at Cambridge. From this time his publications became very frequent, both in theology and mathematics. By his researches into the writings of the Fathers, he was led to embrace the Arian hypothesis respecting the person of Christ; on account of which he was, in October 1710, deprived of his professorship, and expelled the University of Cambridge, after he had been formally convened and interrogated for some days together. At the conclusion of this year he wrote his "Historical Preface," afterwards prefixed to his "Primitive Christianity Revived," containing the reasons for his dissent from the commonly received notions of the Trinity, which work he published the next year, in 4 vols. 8vo. for which the Convocation fell upon him most vehemently.

In 1713, he and Mr. Ditton composed their scheme for finding the longitude, which they published the year following, a method which consisted in measuring distances by means of the velocity of sound.

On Mr. Whiston's expulsion from Cambridge, he went to London, where he conferred with Doctors Clarke, Hoadly, and other learned men, who endeavoured to moderate his zeal, but he was not to be intimidated; he continued to write, and to propagate his opinions with as much ardour as if he had been in the most flourishing circumstances; which, however, were so bad, that in 1721, a subscription was made for the support of his family, which amounted to 470*l.* For though he drew some profits from reading astronomical and philosophical lectures, and also from his publications, which were very numerous, yet these of themselves were very insufficient: nor, when joined with the benevolence and charity of those who loved and esteemed him for his learning, integrity, and piety, did they prevent his being frequently in great distress.

In 1739, Mr. Whiston put in his claim to the mathematical professorship at Cambridge, then vacant by the death of Dr. Saunderson, in a letter to Dr. Ashton, the Master of Jesus College; but no regard was paid to it. Among a variety of works, he published Memoirs of his own Life and Writings, which are very curious.

Whiston continued many years a member of the established Church; but at length forsook it on account of the reading of the Athanasian Creed, and went over to the Baptists; which happened while he was at the house of Samuel Barker, Esq. at Lindon in Rutlandshire, who had married his daughter; where he died after a week's illness, the 22d of August, 1752, at upwards of eighty-four years of age.

The character of this conscientious and worthy man has been attempted by two very able personages, who were well acquainted with him, namely, Bishop Hare, and Mr. Collins, who unite in giving him the highest applauses for his integrity, piety, &c. Mr. Whiston left some children behind him; among them, Mr. John Whiston, who was for many years a very considerable bookseller in London.

WHITE, one of the colours of bodies. Though white cannot properly be said to be one colour, but rather a composition of all the colours together; for Newton has demonstrated, that bodies only appear white by reflecting all the kinds of coloured rays alike; and that even the light of the sun is only white, because it consists of all colours mixed together.

This may be shown mechanically in the following manner: Take seven parcels of coloured fine powders, the same as the primary colours of the rainbow, taking such quantities of these as shall be proportional to the respective breadths of these colours in the rainbow, which are of red 45 parts, orange 27, yellow 48, green 60, blue 60, indigo 40, and of violet 80; then mix intimately together these seven

parcels of powders, and the mixture will be a whitish colour: and this is only similar to the uniting the prismatic colours together again, to form a white ray or pencil of light of the whole of them. The same thing is done conveniently thus: Let the flat upper surface of a top be divided into 360 equal parts, all around its edge; then divide the same surface into seven sectors, in the proportion of the numbers above, by seven radii or lines drawn from the centre; next let the respective colours be painted in a lively manner on these spaces, but so as the edge of each colour may be made nearly like the colour next adjoining, that the separation may not be well distinguished by the eye; then if the top be made to spin, the colours will thus seem to be mixed all together, and the whole surface will appear of a uniform whiteness: and if a large round black spot be painted in the middle, so as there may be only a broad flat ring of colours around it, the experiment will succeed the better.

White bodies are found to take heat slower than black ones; because the latter absorb or imbibe rays of all kinds and colours, and the former reflect them. Hence it is that black paper is sooner inflamed by a burning-glass, than white; and hence also, black clothes, hung up in the sun by the dyers, dry sooner than white ones.

WHITEHURST, (John,) in biography, an ingenious English philosopher, was born at Congleton, in the county of Cheshire, the 10th of April, 1713, being the son of a clock and watch-maker there. On his quitting school, where it seems the education he received was very defective, he was bred by his father to his own profession, in which he soon gave hopes of his future eminence.

At about the age of twenty-one, his eagerness after new ideas carried him to Dublin, having heard of an ingenious piece of mechanism in that city, being a clock with certain curious appendages, which he was very desirous of seeing, and no less so of conversing with the maker. On his arrival, however, he could neither procure a sight of the former, nor draw the least hint from the latter concerning it. Thus disappointed, he fell upon an expedient for accomplishing his design; and accordingly took up his residence in the house of the mechanic, paying the more liberally for his board, as he had hopes from thence of more readily obtaining the indulgence wished for. He was accommodated with a room directly over that in which the favourite piece was kept carefully locked up; and he had not long to wait for his gratification: for the artist, while one day employed in examing his machine, was suddenly called down stairs; which the young enquirer happening to overhear, softly slipped into the room, inspected the machine, and presently satisfying himself as to the secret, escaped undiscovered to his own apartment. His end thus compassed, he shortly after bid the artist farewell, and returned to his father in England.

About two or three years after his return from Ireland, he left Congleton, and entered into business for himself at Derby, where he soon got into great employment, and distinguished himself very much by several ingenious pieces of mechanism, both in his own regular line of business, and in various other respects, as in the construction of curious thermometers, barometers, and other philosophical instruments, as well as in ingenious contrivances for water-works, and the erection of various larger machines: being consulted in almost all the undertakings in Derbyshire, and in the neighbouring counties, where the aid of superior skill in mechanics, pneumatics, and hydraulics, was requisite.

In this manner his time was fully and usefully employed in the country, till, in 1775, when the act being passed for the better regulation of the gold coin, he was appointed stamper of the money-weights; an office conferred upon him, altogether unexpectedly, and without solicitation. Upon this occasion he removed to London, where he spent the remainder of his days, in the constant habits of cultivating some useful parts of philosophy and mechanism.

In 1778, Mr. Whitehurst published his Inquiry into the Original State and Formation of the Earth; of which a second edition appeared in 1786, considerably enlarged and improved; and a third in 1792. This was the labour of many years; and the numerous investigations necessary to its completion, were in themselves also of so untoward a nature as, at times, though he was naturally of a strong constitution, not a little to prejudice his health. When he first entered upon this species of research, it was not altogether with a view to investigate the formation of the earth, but in part to obtain such a competent knowledge of subterraneous geography, as might become

subservient to the purposes of human life, by leading mankind to the discovery of many valuable substances which lie concealed in the lower regions of the earth.

May the 13th, 1779, he was elected and admitted a Fellow of the Royal Society. Before he was admitted a member, three several papers of his had been inserted in the Philosophical Transactions, *viz*. Thermometrical Observations at Derby, in vol. 57; An Account of a Machine for raising Water, at Oulton, in Cheshire, in vol. 65; and Experiments on Ignited Substances, vol. 66: which three papers were printed afterwards in the collection of his works in 1792.

In 1783, he made a second visit to Ireland, with a view to examine the Giant's Causeway, and other northern parts of that island, which he found to be chiefly composed of volcanic matter: an account and representation of which are inserted in the latter editions of his Inquiry During this excursion he erected an engine for raising water from a well, to the summit of a hill, in a bleaching ground at Tullidoi, in the county of Tyrone, which is worked by a current of water.

In 1787, he published An Attempt toward obtaining Invariable Measures of Length, Capacity, and Weight, from the Mensuration of Time. His plan is, to obtain a measure of the greatest length that conveniency will permit, from two pendulums whose vibrations are in the ratio of 2 to 1, and whose lengths coincide nearly with the English standard in whole numbers. The numbers which he has chosen show much ingenuity. On a supposition that the length of a second's pendulum, in the latitude of London, is $39\frac{1}{5}$ inches, the length of one vibrating 42 times in a minute, must be 80 inches; and of another vibrating 84 times in a minute, must be 20 inches; and their difference 60 inches, or five feet, is his standard measure. By the experiments, however, the difference between the lengths of the two pendulum rods, was found to be only 59,892 inches, instead of 60, owing to the error in the assumed length of the second's pendulum, $39\frac{1}{5}$ inches being greater than the truth, which ought to be $39\frac{1}{8}$ very nearly. By this experiment, Mr. Whitehurst obtained a fact, as accurately as may be in a thing of this nature, *viz*. the difference between the lengths of two pendulum rods whose vibrations are known: a datum from whence may be obtained, by calculation, the true lengths of pendulums, the spaces through which heavy bodies fall in a given time, and many other particulars relating to the doctrine of gravitation, the figure of the earth, &c.

Mr. Whitehurst had been at times subject to slight attacks of the gout, and he had for several years felt himself gradually declining. By an attack of that disease in his stomach, after a struggle of two or three months, it put an end to his laborious and useful life, on the 18th of February, 1788, in the 75th year of his age, at his house in Bolt Court, Fleet-street, being the same house where another eminent self-taught philosopher, Mr. James Ferguson, had immediately before him lived and died

WILKINS (Dr. JOHN), in biography, a very ingenious and learned English bishop and mathematician, was the son of a goldsmith at Oxford, and born in 1614. After being educated in Greek and Latin, in which he made a very quick progress, he was entered a student of New Inn in that university, when he was but thirteen years of age; but after a short stay there, he was removed to Magdalen Hall, where he took his degrees. Having entered into holy orders, he first became chaplain to William Lord Say, and afterwards to Charles Count Palatine of the Rhine, with whom he continued for some time. Adhering to the Parliament during the civil wars, they made him warden of Wadham College about the year 1648. In 1656 he married the sister of Oliver Cromwell, then lord protector of England, who granted him a dispensation to hold his wardenship, notwithstanding his marriage. In 1659, he was by Richard Cromwell made master of Trinity College in Cambridge; but ejected the year following, upon the restoration. He was then chosen preacher to the society of Gray's Inn, and rector of St. Lawrence Jewry, London, upon the promotion of Dr. Seth Ward to the bishoprick of Exeter. About this time he became a member of the Royal Society, was chosen of their council, and proved one of their most eminent members. He was afterwards made dean of Rippon, and in 1668 bishop of Chester; but died of the stone in 1672, at fifty-eight years of age.

Burnet writes, that "he was a man of as great a mind, as true a judgment, as eminent virtues, and of as good a soul, as any he ever knew; that though he married Cromwell's sister, yet he made no other use of that alliance, but to do good offices, and to cover the university of

Oxford from the sourness of Owen and Goodwin. At Cambridge, he joined with those who studied to propagate better thoughts, to take men off from being in parties, or from narrow notions, from superstitious conceits, and fierceness about opinions. He was also a great observer and promoter of experimental philosophy, which was then a new thing, and much looked after. He was naturally ambitious, but was the wisest clergyman I ever knew. He was a lover of mankind, and had a delight in doing good."

Of his publications, which are all of them very ingenious and learned, and many of them particularly curious and entertaining, the first was in 1638, when he was only twenty-four years of age, *viz.* "The Discovery of a New World; or, a Discourse, to prove that it is probable there may be another Habitable World in the Moon; with a discourse concerning the Possibility of a Passage thither." In 1640, "A Discourse concerning a New Planet, tending to prove that it is probable our Earth is one of the Planets." In 1641, "Mercury, or, the secret and swift Messenger; showing how a man may with privacy and speed communicate his thoughts to a friend at any distance;" 8vo. In 1648, "Mathematical Magic; or, the Wonders that may be performed by Mathematical Geometry;" 8vo. All these pieces were published entire in one volume, 8vo. in 1708, under the title of "The Mathematical and Philosophical Works of the Right Rev. John Wilkins," &c. To this collection is also subjoined an abstract of a larger work, printed in 1668, folio, entitled "An Essay towards a real Character and a philosophical Language."

WILL In the Hartleyan acceptation of the term, the will is that state of mind which is immediately previous to, and causes those express acts of memory, imagination, reasoning, or bodily motion, which we term voluntary; corresponding to the common acceptation of the term *volition*. In the more customary use of the term, it comprehends the whole class of feelings by which volition is produced, (for an account of which, see MENTAL PHILOSOPHY, § 63—99).

It would be an interesting and very important inquiry, how far volition may become connected with and regulate the trains of thought and feeling, and the state of mind which we call attention; but this would lead us into a field which neither our limits of time, nor of space, would allow us to survey even cursorily. That such connection can be formed in various instances, there is no room for doubt; and were it otherwise, man would be merely the creature of external circumstances: that, on the other hand, there are limits to such establishment, is also indisputable; and were it not so, man might become the creator of his own mind, and all the benefits arising from the intellectual and social powers depend upon caprice. But we must content ourselves with laying before our readers some of Hartley's valuable practical remarks respecting the will.

"The will appears to be nothing but a desire or aversion, sufficiently strong to produce an action that is not automatic, primarily or secondarily (§ 101). The will is therefore that desire or aversion which is strongest for the present time; for if any other desire were stronger, the muscular motion connected with it by association would take place, and not that which proceeds from the will, or the voluntary one.

"Since the things which we pursue do, when obtained, generally afford pleasure, and those which we fly from affect us with pain, if they overtake us, it follows that the gratification of the will is generally associated with pleasure, the disappointment of it with pain. Hence a mere associated pleasure is transferred upon the gratification of the will; a mere associated pain, upon the disappointment of it: and if the will were always gratified, this mere associated pleasure would, according to the present frame of our natures, absorb, as it were, all our other pleasures; and thus, by drying up the source from whence it sprung, be itself dried up at last; and the first disappointments, after a long course of gratification, would be intolerable. Both which circumstances are sufficiently observable, in an inferior degree, in children that are much indulged, and in adults, after a long series of successful events. Gratifications of the will without the consequent expected pleasure, and disappointments of it without the consequent expected pain, are particularly useful to us here: and it is by this, amongst other means, that the human will is brought to a conformity with the divine; which is the only radical cure for all our evils and disappointments, and the only earnest and medium for obtaining lasting happiness.

"We often desire and pursue things which give pain rather than pleasure. Here it must be supposed that at first

they afforded pleasure, and that they now give pain on account of the change in our nature and circumstances. Now, as the continuance to desire and pursue such objects, notwithstanding the pain arising from them, is the effect of the power of association; so the same power will at last reverse its own steps, and free us from such hurtful desires and pursuits. The recurrency of pain will at last render the object undesirable and hateful; and the experience of this painful process, in a few particular instances, will at last, as in other cases of the same kind, beget a habit of ceasing to pursue things, which we perceive by a few trials, or by rational arguments, to be hurtful to us on the whole.

"A state of desire ought to be pleasant at first, from the near relation of desire to love (§ 71), and of love, to pleasure and happiness; but in the course of a long pursuit, there intervene so many fears and disappointments, apparent or real, with respect to the subordinate means, and so many strong agitations of mind passing the limits of pleasure, as greatly to chequer a state of desire with misery. For a similar reason, states of aversion are chequered with hope and comfort."

WILL, *freedom of.* There are, perhaps, few topics of inquiry which have more than this perplexed the understandings and irritated the passions of mankind. From the continued conflict of opinion which has existed on the subject, in every age since the operations of the mind of man became a frequent subject of investigation, it might be almost presumed to belong to those questions which furnish abundant matter for discussion, but none for conviction; which sharpen ingenuity, without resulting in certainty; and serve to display the human intellect in all its strength and weakness, in all its pride and humiliation.

Philosophical free-will, it must ever be remembered, is something totally different from external liberty. The latter is possessed by every man who has the power of doing as he pleases; that is, of carrying his volitions into execution. But whether volitions be free or necessitated; whether, in forming these, the mind exert a self-determining power, or be uniformly and irresistibly influenced by motives, is a question perfectly unconnected with the circumstances of freedom or control, relating to their execution. The will may be bound, though the consequent act be unimpeded; and, on the other hand, the exercise of the self-determining power, in volition, may be prevented, by numberless restraints, from being followed up in act. The point in discussion between the advocates of philosophical free-will and their opponents is, whether man be invariably and necessarily influenced by motives; or, whether he possess a self-governing, self-determining power, which he may exert by acting either according to motives, in opposition to motives, or without any motives at all. And though some of the defenders of liberty differ from others in the extent of the exercise of this power, many limiting it to acts of mere deliberation, and others connecting it with every actual and possible instance of volition, the controversy between them and the necessarians has no reference to these differences, but is circumscribed by the single question, whether, in any case whatever, a volition can originate independently of motive; or, in other words, whether the mind be capable of acting differently, previous circumstances continuing in every respect the same. In support of philosophical liberty, its supporters make their first appeal to consciousness. With respect to various volitions, it is observed, we are not only insensible to an overpowering and resistless influence of motives, but are positively conscious of choosing without any motive, and often even in opposition to the strongest. And were it not that the mind possessed this paramount and independent faculty—this liberty of determining differently in the same circumstances, whence could arise those feelings of approbation or blame, which ever attach to volitions of high importance and moral consequence? Could censure reasonably be applied to any act that was inevitable? or is there any adequate ground of applause for what could not possibly have been unperformed? Are not the feelings of individuals, and the consent of nations, on this subject, perfectly decided and coincident? The repentant sinner is overwhelmed with remorse for that delinquency which he feels it was no less within his power than his duty to have avoided: the abandoned criminal, who has lifted his murderous arm against his neighbour, falls an unpitied victim to the laws of his country. Upon what principle is remorse felt in the one case, and execution inflicted in the other, but on that which naturally presses conviction on every human bo-

som, that the offender, instead of being hurried on to guilt by irresistible destiny, was merely the ready tool of appetites which he might have controuled; the willing slave of passions which he might have corrected. The lunatic incendiary is regarded as no proper object of punishment, frenzy having usurped the throne of reason, and the exercise of rational free-will being precluded by the paroxism of disease. And, on similar grounds, the destroyer of life by mere accident, is exempt from the vengeance of human laws, which point their thunder only against those who are both capable of distinguishing right from wrong, and of avoiding the crimes into which they voluntarily plunge themselves. If, therefore, any conclusion whatever can be justly inferred from the almost instinctive feelings of mankind, which even those uniformly act upon who systematically controvert and ridicule them, how powerful must the argument, hence derived, be considered in favour of that liberty of will, without which the agonies of remorse appear only the gratuitous self-inflictions of folly; and the most essential acts of legislation, seem the most execrable operations of tyranny? The moral and religious consequences, considered as arising from the system of necessity, are regarded by the advocates for free-will as of a nature so repulsive to the interests of virtue, so incompatible with moral discipline, so full of palpable absurdity and extreme impiety, that these alone are deemed sufficient to justify the rejection of a doctrine, from which they appear essentially and decidedly to flow. Can that system, it is asked, be true, which saps the foundations of virtue, by ascribing every act and thought, every feeling and wish, connected with moral character, to imperious and resistless impulse? which constitutes man a mere machine, guiltless even in the extreme of wickedness, and worthless in the maturity of benevolence; because in both cases, equally compelled by circumstances to good or evil, and equally destitute of moral quality with the quickening sun or the devouring tempest? If every sentiment and deed of every human individual be the result of preceding situations, which situations themselves are only links in an interminable series of processes, equally compelled and necessitating, how vain are all the popular and presumed means of operating upon the mind, to reclaim from vice, or to guide to virtue? Can there be any stimulus to exertions decidedly fruitless? or can there be any penitence for inevitable crime? or can there be any justice, human or divine, in the punishment of offences committed, indeed, by choice, yet committed through necessity? With what disgust will be viewed the imputation thrown by this system on the Supreme Being (who is considered by it to be not only the sovereign, but the sole agent, in the universe), as the origin of all existing evil! Under what character is the Divine Being represented by this doctrine, but under that of a baffling tyrant, and a deriding fiend; exhorting men to what they cannot accomplish, and torturing them for what they cannot avoid, and, under the designation of the God of truth, uttering a tissue of the most malignant falsehoods? With what horror must we contemplate a Deity, who is exhibited as the very author of what he professes to hate, the performer of what he punishes, and the source of every polluted thought, every tormenting passion, and every evil work; whose chosen instruments and objects appear to be, hatred and uncharitableness, guilt and terror, confusion, pain, and death; who is displayed, in short, as the introducer of all moral evil, and the scourge of all moral nature?

It is by no means surprising that observations, or arguments, such as these, should have operated strongly on the majority even of persons in some degree habituated to reflection. The moral man has trembled for the interests of virtue; the pious man has recoiled from the dreaded charge of blasphemy; and so coincident is the misapprehended system of liberty with the feelings of indiscriminating and unreflecting minds, that it would be truly extraordinary if the opposite doctrine had not to encounter from such, prejudices the most violent and hostile. General consent, however, and presumed consciousness, are no more sufficient to establish the doctrine of philosophical free-will, than the appearance exhibited by the sun and stars of revolving round this terraqueous globe, and the universal conviction once entertained of the reality of this appearance, can be considered to have been irrefragable evidence of this popular philosophy. And with regard to the interests of virtue, and even the honour of the Deity, the man who refrains from the discussion of important topics, from a

trembling apprehension lest these should be injuriously involved in the result of his investigation, displays inexpressibly more of fastidious sensibility than of vigorous intellect. If discussion can possibly evince that virtue is detrimental or worthless, instead of being extolled as the best source of hope, and the only guide to happiness, let it be instantly exposed to the aversion and avoidance of mankind. And if the most acute and profound speculation can possibly disconnect from the Supreme Being those qualities of wisdom and goodness, of power and perfection, which have hitherto only appeared the more clearly to belong to him the more his attributes have been investigated, let the veil be, at once, rent from the imagined sanctuary, and let detestation or contempt be substituted for joyful devotion and humble imitation. These delicate scruples, and fearful doubts, and awful hesitations, have too long retarded the march of the human mind in its pursuit of the ends and means most worthy of its researches. They have been in every age supports, as, indeed, they are results, of superstition: they have aided the views of civil tyranny, and inquisitorial bigotry; and until the operations of thought be unimpeded by these morbid tremours, any rapid advance to the maturity of social institutions can be expected only in vain. In opposition, then, to the doctrine of free-will, so tenaciously maintained, and so ardently advocated, it may be observed, that upon the only sound principles of philosophy, upon the very basis of all human speculation and conclusion, the imagined liberty of man will appear equally unsupportable, as any change in the arrangements of material nature without a corresponding change of pre-existing circumstances. If volitions, in any case, start up in the mind uncaused, as well may it be presumed, that the universal system of nature sprang into existence without any previous and operative energy. All inquiry into causes is vain; all reference to circumstances is absurd: conclusions, the most opposite, may, with equal propriety, be inferred from the same premises; or, rather, the only conclusion to be formed is, that of one immense and universal chaos, in which processes, both of mind and matter, are incipient without cause, and operative without effect. If, on the other hand, man be uniformly and imperiously influenced by motives, volitions are as definitive, in definite circumstances, as the movements of palpable mechanism; and the determinations of the mind are equally decided and inevitable, as the inclinations of the balance. The most animated display of evils, imagined to result from the system of necessity, will scarcely induce any vigorous and unprejudiced mind to surrender the only basis on which inference can be formed and inquiry instituted. But the principles of religion are equally adverse to free-will with the axioms of philosophy; and it is curious to observe, that the doctrine of liberty, under consideration, meets with its destruction in what may be regarded, possibly, as the very source of its existence. Sentiments of religion, unquestionably, suggested the expediency of human freedom, to screen the character of Deity from imputation on the ground of natural and moral evil; and man was thus invested with a paramount and mysterious faculty, by which, in circumstances precisely the same, he is capable of performing any action, or its opposite. By a fallacy, more reverential than ingenious; by a sophism, such as in ordinary life would expose its employers to instant detection and ridicule, this pre-eminent power, though admitted to be communicated, is considered as the efficient cause of all that evil which it was regarded indecorous and blasphemous to ascribe to Deity. The responsibility on this subject, which was conceived to reflect severely on the character of God, by this accommodating invention, was imagined to be easily and happily removed. But if piety has, upon this curious ground, contributed to establish the belief in human free-will, it has no less decidedly maintained the doctrine of divine omniscience: yet to unite these articles in the same creed, must be regarded by the unbiassed inquirer as absolutely and eternally impossible. How can it be within the power of man to avoid doing what God foresees he will perform? or how can that remain undone which is foreknown, and unquestionably, therefore, certainly will be accomplished? What becomes of that boasted liberty, which is incapable of being exerted, and the exercise of which, though strangely denied to be precluded by necessity, it must be at least admitted, has to encounter the most indubitable and decided certainty? And how is the difficulty which, on every other system, presses from the consideration of existing evil, at all mitigated by an hypothesis, which merely transfers the charge from the principal to the agent: from the

Creator to the creature; from the bestower of the faculty of freedom, who must be aware of all its possible applications and consequences, and who therefore, in the eye of reason, intends all the effect, of the principle he thus communicates, to the frail possessor and foreseen abuser of it? With respect, moreover, to moral discipline, how can any system, which has this object in view, be at all applicable to beings, whose merit and perfection are supposed to consist in a total superiority to motive; who can resist the strongest applications of menace or conciliation, of remuneration or penalty; with whom caprice alone is principle, and chance direction; and an indefinable, unintelligible power of self-determination, without the aid of motive, or even in diametrical opposition to the strongest, is the substitute for all steady object and rational inducement? With regard to virtue, in this system, its maturity consists not in useful tendencies and affections, so confirmed by habit as to have acquired almost an incapability of effectual counteraction, a definition founded on the only correct theory of the human mind, and which presents the most admirable and impressive lessons of morality, but in an imagined principle or faculty which has no perceivable connection with character, habit, or affection; and in proportion to the degree in which any intelligent agent can be supposed to act from this unmotived faculty, in that proportion must he be presumed less capable of forming those fixed and almost indestructible associations which are the sole security of moral excellence. Free-will, then, thus appears to be in irreconcileable hostility with the fundamental principle of human discussion and investigation, on every subject moral or material, that every thing which begins to be must have a cause: its complete operation excludes man from the possibility of virtuous habits, as these can result solely from his definite impressibility by definite circumstances: it prevents any consistent application of threats or exhortation, of reward or punishment; because, to a mind unguided and ungovernable by motive, these are equally useless as expostulation with a storm, or advice to a conflagration. Finally, from the character of God it snatches that attribute, without which Providence must be supposed to be any thing rather than what the term naturally implies. Instead of a superintending Deity, foreseeing every event, affected by no surprize, and subject to no disappointment, we are presented with a governor at the helm of Nature, who, in the impressive language of scripture, "knows not what a day may bring forth:" his arrangements may be frustrated by human folly; his happiness may be impaired by human hostility: man, that is a worm, may baffle the views of Divine intelligence, and counteract the energies of Almighty power!

Will and Testament, is that disposition of property which is made by a person to take place after his decease. Every person capable of binding himself by contract, is capable of making a will.

Also a male infant of the age of fourteen years and upwards, and female of twelve years or upwards, are capable of making a will respecting personal estates only. But a married woman cannot make a will, unless a power be reserved in a marriage settlement; but wherever personal property, however, is given to a married woman, for her sole and separate use, she may dispose of it by will.

If a feme sole make her will, and afterwards marry, such marriage is a legal revocation of the will. Wills are of two kinds, written and verbal: the former is most usual and secure.

It is not absolutely necessary that a will should be witnessed; and a testament of chattels, written in the testator's own hand, though it have neither the testator's name nor seal to it, nor witnesses present at his publication, will be good, provided sufficient proof can be had that it is his hand writing. By statute 29 Charles II. c. 3, all devises of lands and tenements shall not only be in writing, but shall also be signed by the party so devising the same, or by some other person in his presence, and by his express direction, and shall be witnessed and subscribed in the presence of the person devising, by three or four credible witnesses, or else the devise will be entirely void, and the land will descend to the heir at law.

A will, even if made beyond sea, bequeathing land in England, must be attested by three witnesses.

A will, however, devising copyhold land, does not require to be witnessed: it is sufficient to declare the uses of a surrender of such copyhold land made to the use of the will. The party to whom the land is given becomes entitled to it by means of the surrender, and not by the will.

A codicil is a supplement to a will, or an addition made by the person making the same, annexed to, and to be taken

as part of the will itself, being for its explanation or alteration, to add something to, or take something from, the former disposition, and which may also be either written or verbal, under the same restrictions as regard wills.

If two wills are found, and it does not appear which was the former or latter, both will be void; but if two codicils are found, and it cannot be ascertained which was the first, but the same thing is devised to two persons, both ought to divide; but where either wills or codicils have dates, the latter is considered as valid, and revokes the former. See ADMINISTRATOR, EXECUTOR, LEGACY.

WILLICHIA, in botany, so named in honour of Christ. Lud. Willich, a genus of the Triandria Monogynia class and order. Essential character: calyx four-cleft; corolla four-cleft; capsule two-celled, many-seeded. There is only one species; *viz.* W. repens, found by Mutis in Mexico.

WILLUGHBEIA, in botany, so named in memory of Francis Willughby, F. R. S. a genus of the Pentandria Monogynia class and order. Natural order of Contortæ. Apocineæ, Jussieu. Essential character: contorted; corolla salver-shaped; stigma-headed; fruit a one or two-celled berry or pumpkin. There are two species; *viz.* W. acida and W. scandens, both natives of Guiana.

WIND. See METEOROLOGY.

WIND *gage*, in pneumatics, an instrument serving to determine the velocity and force of the wind. See ANEMOMETER, ANEMOSCOPE.

Dr. Hales had various contrivances for this purpose. He found, that the air rushed out of a smith's bellows at the rate of 68¾ feet in a second of time, when compressed with a force of half a pound upon every square inch lying on the whole upper surface of the bellows. The velocity of the air, as it passed out of the trunk of his ventilators, was found to be at the rate of 3,000 feet in a minute, which is at the rate of 34 miles an hour. The same author says, that the velocity with which impelled air passes out at any orifice, may be determined by hanging a light valve over the nose of a bellows, by pliant leather hinges, which will be much agitated and lifted up from a perpendicular, to a more than horizontal position, by the force of the rushing air.

M. Bouguer contrived a simple instrument, by which may be immediately discovered the force which the wind exerts on a given surface. This is a hollow tube, A A, B B, (Plate XVI. Miscel. fig. 13.) in which a spiral spring, C D, is fixed, that may be more or less compressed by a rod, F S D, passing through a hole within the tube at A A. Then having observed to what degree different forces or given weights are capable of depressing the spiral, mark divisions on the rod in such a manner, that the mark at S may indicate the weight requisite to force the spring into the situation, C D: afterwards join at right angles to this rod at F, a plane surface, C F E, of any given area at pleasure; then let this instrument be opposed to the wind, so that it may strike the surface perpendicularly, or parallel to the rod; then will the mark at S show the weight to which the force of the wind is equivalent.

The following Table will give the different velocities and forces of the wind, according to their common appellations.

Velocity of the wind. Miles in one hour.	= feet in one second	Perpendicular force on one sq. foot in averdupois pounds.	Common appellations of the wind.
1	1.47	.005	Hardly perceptible.
2	2.93	.020	Just perceptible.
3	4.40	.044	
4	5.87	.079	Gentle pleasant wind.
5	7.33	.123	
10	14.67	.492	Pleasant brisk gale.
15	22.00	1.107	
20	29.34	1.968	Very brisk.
25	36.67	3.075	
30	44.01	4.429	High winds.
35	51.34	6.027	
40	58.68	7.873	Very high.
45	66.01	9.963	
50	73.35	12.300	A storm or tempest.
60	88.02	17.715	A great storm.
80	117.36	31.490	A hurricane.
100	146.70	49.200	A hurricane that tears up trees and carries buildings, &c. before it.

The force of the wind is nearly as the square of the velocity, or but little above it in these velocities. But the force is much more than in the simple ratio of the surfaces, with the same velocity, and this increase of the ratio is the more, as the velocity is the more. By accurate experiments with two planes, the one of 17¼ square inches, the other

of 32, which are nearly in the ratio of 5 to 9. Dr. Hutton found their resistances, with a velocity of 20 feet per second, to be the one, 1.196 ounces, and the other, 2.542 ounces; which are in the ratio of 8 to 17, being an increase of between one-fifth and one-sixth parts more than the ratio of the surfaces.

WINDLASS, a machine used to raise heavy weights withal, as guns, stones, anchors, &c. It is very simple, consisting only of an axis, or roller, supported horizontally at the two ends, by two pieces of wood and a pulley: the two pieces of wood meet at top, being placed diagonally, so as to prop each other; the axis, or roller, goes through the two pieces, and turns in them. The pully is fastened at top where the pieces join. Lastly, there are two staves or handspikes go through the roller, whereby its is turned, and the rope which comes over the pulley is wound off and on the same.

WINDLASS, in a ship, is an instrument in small ships, placed upon the deck, just abaft the foremast. It is made of a piece of timber, six or eight feet square, in form of an axle-tree, whose length is placed horizontally upon two pieces of wood at the ends thereof, upon which it is turned about by the help of handspikes put into holes made for that purpose. This instrument serves for weighing anchors, or hoisting of any weight, in or out of the ship, and will purchase much more than any capstan, and that without any danger to those that heave; for if in heaving the windlass about, any of the handspikes should happen to break, the windlass would pall of itself.

WINDMILL, a kind of mill, the internal parts of which are much the same with those of a water-mill; from which, however, it differs, in being moved by the impulse of the wind upon its vanes or sails, which are to be considered as a wheel on the axle. Plate, Windmill, is a vertical section of a windmill of that kind, which is called a smock-mill, *i. e.* when the building, the mill, and machinery are fixed, and the head of the mill supporting the axis of the sails turns round upon it. A A are the walls of the mill-house, which is longer one way than the other, and the section is through the shortest side; in this direction it will but just contain the machinery, and leave a passage; in the other direction the house is longer, and is used as a warehouse to stow the corn and flour. The roof of the house is framed of large beams, a flooring is laid on these beams, and then the whole is covered with sheet lead. Eight long upright beams, B B, are framed into the roof of the house, and disposed round in a circle; at the upper angle they support a circular kirb, D D; the eight uprights, B B, are braced by cross pieces framed between them, so as to render the whole building very staunch; the outside is covered with weather-board, just to shoot off the rain, but open enough to admit the wind to pass freely through the house. Upon the upper fixed kirb, D D, thirty-six rollers are placed (two of them are seen in the section;) these rollers turn in mortices, cut through a circular ring of wood, which keeps the thirty-six rollers in their places, and at their proper distances from one another. The rollers support another circular wooden ring, *a a*, on which the head of the mill is framed. This framing consists of two beams, *b*, halved into the ring, parallel to the main axis of the sails, and including the great cog wheel between them, only one of them is shown in the figure, the other being taken away in the section. Two cross beams, *d* and *e*, bolted upon *b b*, supports the bearings for the main axis, and another cross beam, *f*, bolted to the under side of *b*, to sustain the upper bearing for the vertical axis.

We now come to speak of the machinery: H H, are two of the four sails seen edgeways; the broad part of the sails, which is covered with cloth, is set oblique to the plane of the sails, motion, and the axis of the sails is set in the direction of the wind; it is by the action of the wind upon the oblique sail, that it is made to revolve on its axis; the wind acts constantly as a wedge upon the sails, and thus drives them round. The four sails are firmly bolted to an iron cross, *e*, cast in one piece with the main: *a b c d e f g* is a wooden pole fixed on at the intersection of the four sails, and forming a continuation of the axis; four ropes are extended from the end of the pole to the end of the sails, and hauled tight by a block of pulleys, by these the sails are stiffened, and prevented from bending by the action of the wind upon them: *h* is the main cog wheel, fixed upon the iron axis, and turning round with it; it has a flexible ring of wood, composed of five segments, and jointed together by iron hinges, and compassing it; one end of this ring of wood, called the brake, is fastened by a joint to the under side of the beam, *b*;

the other end comes round nearly to the same point, and is fastened to a long lever, *i*, called the brake lever. When this lever is lifted up, the brake is lifted off from the wheel, and does not touch it on any part, and the wheel and sails can turn; but when the lever is suffered to fall down, the brake closes round the wheel, and prevents the wheel and sails from turning. The brake lever is lifted up by a rope, *k*, which hangs down in reach of the miller when standing on the stage, I I, built round the mill for the purpose, as also for clothing or unclothing the sails. When the brake is to be held up for any length of time, while the mill is at work, the brake rope is hooked on a hook driven into one of the uprights, BB. The head of the mill can be turned round upon the thirty-six rollers, to set the sail round in the proper direction to meet the wind. The fixed kirb, D D, has a ring of cogs all round its outside, which work with a pinion on a spindle, *l*, turning in a socket fixed by iron braces. To the moveable head of the mill, on the upper end of the spindle, *l*, a crown wheel is fixed, which is turned by a small pinion on the same spindle, with a wheel, *m*, round which an endless rope runs, and which hangs down in reach of the miller when on the stage, I. By pulling down one side of the endless rope he turns the wheel, *m*, and by the pinion the crown wheel, and its pinion, which acting against the teeth in the kirb, D, turns the head round upon the thirty-six rollers, and puts the sails in any position according to the wind: *o* is a roller turned upon an iron pin fastened to the under side of the beam, *b*, and acting against the inside of the kirb; another similar roller is fixed to the other beam, which is parallel to *b*; their use is to keep the head steady upon the rollers, otherwise the head might be thrown backwards by the action of the wind upon the sails. The upper part of the head is light framing and thin boards, covered with copper just to exclude the rain. The main cog-wheel, *h*, turns a trundle, K, on the upper end of a long vertical shaft, L L, which comes down to the ground, and turns in a socket supported on Masonry at M: *p* is a crown wheel of fifty-six teeth turning another wheel of seventeen teeth on horizontal, which has riggers, *g*, on it to turn bolting mills and dressing machines in the upper room. In the lower room a large spur-wheel, *t*, of seventy-two teeth, is fixed, and turns a nut on each side of it, one of twenty-eight, the other of twenty-six teeth, on the spindles of their respective mill-stones, *r* and *s*.

The construction of the mill for grinding flour is well explained in the article MILL, to which we refer our readers.

WIND *sails*, in a ship, are made of the common sail cloth, and are usually between twenty-five and thirty feet long, according to the size of the ship, and are of the form of a cone ending obtusely: when they are made use of, they are hoisted by ropes to about two-thirds or more of their height, with their bases distended circularly hoops, and their apex hanging downwards in the hatchways of the ship; above each of these one of the common sails is so disposed, that the greatest part of the air rushing against it, is directed into the wind-sail, and conveyed as through a funnel, into the upper parts of the body of the ship.

WINDAGE *of a gun*, the difference between the diameter of the bore, and the diameter of the ball.

WINE. See FERMENTATION, &c. All wines contain an acid, alcohol, tartar, extract, aroma, and a colouring matter. The presence and nature of each of these principles may be ascertained in the following way. 1. Acid. All wines, even the softest and mildest, redden litmus, and therefore contain an acid. This abounds, however, chiefly in the thin wines of wet and cold climates, where the grape juice or must contains but a small portion of sugar. When wine has been boiled to extract the brandy, the liquor that remains in the still, and is thrown away as useless, is a sour nauseous fluid, with an acrid and burnt flavour. When filtered and allowed to remain at rest for a time, it deposits a good deal of extractive matter, becomes covered with mould, and then contains a notable quantity of acetous acid, which may be separated by distillation. The acid is, however, not entirely acetous, at least not till after standing a considerable time, for it precipitates and forms an insoluble salt with lime water, and with the soluble salts of silver, lead, and mercury, and appears to be the malic acid mixed with a little citric, both of which are converted into vinegar by spontaneous decomposition. The wines that contain the greatest quantity of these acids yield the worst brandy, nor is there any method yet known of separating or neutralizing the acid without materially injuring the quality, or lessening the quantity of the ardent spirit. 2.

Alcohol. The existence of this principle and mode of extraction by distillation has been fully described under the article brandy. The quantity of alcohol varies prodigiously. The strong, rich, full-bodied wines of the warmer vine countries will yield as much as a third of ardent spirit; whilst the thin light wines will often give no more than about one-sixteenth of the same strength. 3. Tartar. This substance has also been fully described in its proper place. Tartar is not altogether a product of the fermentation of wine, since it is contained in must, though in small quantity. 4. Extract. Must contains an abundance of extractive matter, which materially assists the fermentation, and is afterwards found, in part at least, in the lees, but another portion may be obtained from the wine by evaporation. It is also extract that mixes with and colours the tartar. By age the quantity of extractive matter diminishes. 5. Aroma. All wines possess a peculiar and grateful smell, which would indicate a distinct aromatic principle, but it has never been exhibited in the form of essential oil, or condensed in any smaller quantity by distillation or any other mode. To give wine all its aroma it should be fermented very slowly. 6. Colouring matter. The husk of the red grape contains a good deal of colour, which is extracted when the entire fruit is pressed, and becomes dissolved in the wine when the fermentation is complete. Many substances will separate the colour. If lime-water is added to high-coloured wine, a precipitate is formed of malat of lime that carries down with it all the colouring matter, which cannot again be separated either by water or alcohol. But if wine alone is evaporated gently to dryness, and the residue treated with alcohol, the colouring matter dissolves therein. We may add too, that the natural colour of wine is entirely and speedily destroyed by the addition of hot well-burnt charcoal in pretty fine powder. The colour of red wine in the state in which we receive it is not entirely that of the grape, but is given by other colouring substances, which, however, are quite innoxious.

WINGED, in botany, a term applied to such stems of plants as are furnished all their length with a sort of membranaceous leaves, as the thistle, &c. Winged leaves, are such as consist of divers little leaves, ranged in the same direction, so as to appear only as the same leaf. Such are the leaves of agrimony, acacia, ash, &c. Winged seeds, are such as have down or hairs on them, which, by the help of the wind, are carried to a distance.

WINGS, in heraldry, are borne sometimes single, sometimes in pairs; in which case they are called conjoined. When the points are downward, they are said to be inverted; when up, elevated.

WINGS, in military affairs, are the two flanks or extremes of an army, ranged in form of a battle; being the right and left sides thereof.

WINGS, in fortification, denote the longer sides of horn-works, crown-works, tenailles, and the like out-works; including the ramparts and parapets, with which they are bounded on the right and left from their gorge to their front.

WINTERA, in botany, so named from Captain William Winter, who brought the bark of this tree from the Straits of Magellan, a genus of the Polyandria Tetragynia class and order. Natural order of Magnoliæ, Jussieu. Essential character: calyx three-lobed; petals six or twelve; germs club-shaped; styles none; berries four or eight, obovate. There are three species.

WIRE *drawing*, the art of drawing out long bars of metal, by pulling it through holes in a plate of steel, or other fit metallic compound. In order that a wire may be drawn, it is requisite that the metal should have considerable tenacity. Gold, silver, iron, steel, copper, and their compounds, are most commonly used in the arts. The process is of considerable simplicity. A number of holes, progressively smaller and smaller, are made in a plate of steel, and the pointed end of a bar of metal being passed through, one of them is forcibly drawn by strong pinchers, so as to elongate it by the pressure arising from the re-action of the greased hole: this is the wire; and it is again passed in like manner through another hole a little smaller; and, by continuing the process, the wire has its length increased, and its diameter diminished, to a very great degree. The largest wire may be nearly an inch in diameter, and the smallest we have seen was about one-thousandth part of an inch; but we are assured that silver wire has been made one-fifteen-hundredth of an inch in diameter. The size of these small wires may be ascertained from the weight of a known measure of length, and the specific gravity of the metal. Or, less correct-

ly, the wire may be wound round a pin, and the number of turns counted which make a given length.

Wires are drawn square, and of other figures in their sector. In particular they are drawn grooved, so that any small part will form the pinion of a clock or watch work.

As the violent action of the drawing plate renders the wires hard and brittle, it is necessary to anneal it several times during the course of drawing. Very small holes are made by hammering up the larger, and the point, in very thin wire, is made by rolling or crushing the end by a smooth burnishing tool upon a polished plate.

It is said that soft steel is as good for the wire drawer's plate as that which is hard, or as the compound material which comes from France in wire plates, and is highly esteemed. This has not been yet chemically examined.

Wire *of Lapland*. The inhabitants of Lapland have a sort of shining slender substance in use among them on several occasions, which is much of the thickness and appearance of our silver wire, and is therefore called, by those who do not examine its structure or substance, Lapland wire. It is made of the sinews of the rein-deer, which being carefully separated in the eating, are by the women, after soaking in water, and beating, spun into a sort of thread, of admirable fineness, and strength, when wrought to the smallest filaments; but when larger, is very strong, and fit for the purposes of strength and force. Their wire, as it is called, is made of the finest of these threads, covered with tin. The women do this business, and the way they take is to melt a piece of tin, and placing at the edge of it a horn with a hole through it, they draw these sinewey threads, covered with the tin, through the hole, which prevents their coming out too thick covered. This drawing is performed with their teeth: and there is a small piece of bone placed at the top of the hole, where the wire is made flat, so that we always find it rounded on all sides but one, where it is flat. This wire they use in embroidering their clothes as we do gold and silver; they often sell it to strangers, under the notion of its having certain magical virtues.

WIT, a faculty of the mind, consisting, according to Mr. Locke, in the assembling and putting together of those ideas, with quickness and variety, in which any resemblance or congruity can be found, in order to form pleasant pictures and agreeable visions to the fancy. This faculty, the same author observes, is just the contrary of judgment, which consists in the separating carefully from one another, such ideas wherein can be found the least difference, thereby to avoid being misled by similitude and affinity, to take one thing for another. It is the metaphor and allusion, wherein, for the most part, lies the entertainment and pleasantry of wit, which strikes so lively on the fancy, and is therefore so acceptable to all people, because its beauty appears at first sight, and there is required no labour of thought to examine what truth or reason there is in it. The mind without looking any further, rests satisfied with the agreeableness of the picture, and the gaiety of the imagination; and it is a kind of affront to go about to examine it by the severe rules of truth or reason. Wit is also an appellation given to the person possessed of this faculty; and here the true wit must have a quick succession of pertinent ideas, and the ability of arranging and expressing them in a lively and entertaining manner; he must at the same time have a great deal of energy and delicacy in his sentiments; his imagination must be sprightly and agreeable, without any thing of parade or vanity in his discourse: but it is not, however, essential to the character of a wit, to be ever hunting after the brilliant, studying sprightly turns, and affecting to say nothing but what may strike and surprise.

WITENA-*mot*, or Witena *gemot*, among our Saxon ancestors, was a term which literally signified the assembly of the wise men, and was applied to the great council of the nation, of latter days called the parliament.

WITHERINGIA, in botany, so named in honour of William Withering, M. D. F. R. S. a genus of the Tetrandria Monogynia class and order. Natural order of Luridæ. Solaneæ, Jussieu. Essential character: corolla subcampanulate, with four bumps in the tube; calyx very small, indistinctly four-toothed; pericarpium two-celled. There is only one species; *viz.* W. solanacea, a native of South America.

WITHERITE, in mineralogy, a species of the genus Barytes: it is commonly of a light yellowish grey colour, usually massive, but sometimes crystallized: specific gravity about 4.3. It melts without addition before the blow-pipe into a white

enamel. It dissolves with effervescence in acids: it consists, according to Klaproth, of

Carbonate of barytes	98.246
Carbonate of strontian	1.703
Alumina with iron	0.043
Carbonate of copper	0.008
	100.000

But, according to other chemists, it consists of

Barytes	74.5
Carbonic acid	25.5
	100.0

It occurs in veins, heavy spar, lead glance, blende, and calamine, and is found in Lancashire. It is a very active poison, but combined with muriatic acid, it may be used with great caution in cases of scrophula.

WITNESS, in law, one who is sworn to give evidence in a cause. If a man be subpœnæd as a witness upon a trial, he must appear in court on pain of 100*l.* to be forfeited to the king, and 10*l.* together with damages equivalent to the loss sustained by the want of his evidence to the party aggrieved. But witnesses ought to have a reasonable time, that their attendance upon the court may be of as little prejudice to themselves as possible; and the Court of King's Bench held, that notice at two in the afternoon to attend the sitting that evening at Westminster, was too short a time.

Where a witness cannot be present at a trial, he may, by consent of the plaintiff and defendant, or by rule of court be examined upon interrogatories at the judge's chambers. No witness is bound to appear to give evidence in a cause, unless his reasonable expense be tendered him; and if he appear, till such charge is actually paid him, except he both resides and is summoned to give evidence within the bills of mortality. See ARREST, EVIDENCE, PRIVILEGE.

WITSENIA, in botany, a genus of the Triandria Monogynia class and order. Natural order of Ensatæ. Irides, Jussieu. Essential character: corolla one-petalled, cylindrical, six-parted; stigma emarginate: capsule superior. There is only one species; *viz.* W. maura, a native of the Cape of Good Hope.

WOAD. See ISATIS.

WOLF. See Canis.

WOLFRAM, in mineralogy, is a species of stone of an intermediate colour between dark greyish black and brownish black, sometimes inclining to velvet black. It occurs massive, and also crystallized; specific gravity somewhere between 6 and 7. It decrepitates before the blow-pipe, and is infusible even with borax. Specimens have been analyzed by several chemists: according to Klaproth and Vauquelin, it consists of

	Klaproth.
Molybdic acid	46.9
Oxide of Iron	31.2
Loss	21.9
	100.0

	Vauquelin.
Molybdic acid	67.00
Oxide of manganese	6.25
Oxide of Iron	18.00
Silica	1.50
Loss	7.25
	100.00

It occurs in primitive mountains, and in the oldest formations. It is usually accompanied with tin, and distinguished from tin-stone by its streak, which is reddish brown, whereas that of tin-stone is grey. See TIN.

WOOD. See TIMBER. The wood of vegetables consists of fibres, impregnated with a variety of the natural juices of the plant, as mucilage, resin, colouring matter, extract, essential oil, sugar, &c. All of these may be obtained from one or other kind of wood, by applying those menstrua which dissolve these substances in their natural state. If a piece of wood be boiled in a great quantity of water, till it no longer gives out taste or smell, and if it be afterwards digested in alcohol, the substance which remains is the woody fibre. It is either in a fibrous, lamellated, or pulverulent form. This substance, which is more or less coloured, has neither taste nor smell; is not altered by exposure to the air; and is insoluble in water and alcohol. When it is heated in contact with air, it blackens, exhales dense, acrid pungent fumes, and leaves behind a coaly matter, which does not change its form. By reducing it to ashes, it is found to contain a little potash, sulphate of potash and lime, and

phosphate of lime. When it is distilled in a retort it yields water, acetic acid contaminated with oil, a thick oily matter, carbonated hydrogen, and carbonic acid gases, and a portion of ammonia, combined with acetic acid. The pure ligneous fibre is decomposed by being heated with strong nitric acid, and yields a very considerable quantity of oxalic and malic acid. The surface of wood is readily stained by a variety of substances; and if these are allowed to remain in contact with it, they sink into the substance of the wood, which often produces a very agreeable effect in cabinet work.

Wood, *cutting in,* is used for various purposes; as for initial and figured letters, head and tail pieces of books; and even for schemes, mathematical and other figures, to save the expense of engraving on copper: and for prints and stamps for papers, calicoes, linens, &c. The invention of cutting in wood, as well as that in copper, is ascribed to a goldsmith of Florence: but Albert Durer and Lucas brought both these arts to perfection. About two hundred years ago, the art of cutting in wood was carried to a very great pitch, and might even vie, for beauty and justness, with that of engraving on copper: at present it is much neglected, the application of artists being wholly employed on copper, as the more easy and promising province: not but that wooden cuts have the advantage of those in copper in many respects; chiefly for figures and devices in books; as being printed at the same time, and in the same press with the letters: whereas, for the other, there is required a particular and separate impression. The cutters in wood begin with preparing a plank or block of the size and thickness required, and very even and smooth on the side to be cut: for this they usually take pear tree, or box; but the latter is best, as being closest, and least liable to be worm eaten. On this block they draw their design with a pen or pencil, exactly as they would have it printed; or they fasten the design drawn on paper upon the block with paste and a little vinegar, the strokes or lines turned towards the wood. When the paper is dry, they wash it gently with a sponge dipped in water, and then take it off by little and little, rubbing it first with the tip of the finger, till nothing is left on the block but the strokes of ink that form the design, which mark out what part of the block is to be spared or left standing. The rest they cut off very carefully with the points of very sharp knives, chissels, or gravers, according to the bigness or delicacy of the work.

Wood *pecker.* See Picus.

WOODSTONE, in mineralogy. See Hornstone.

WOODTIN, in mineralogy. See Tin *ore.*

WOOF, among manufacturers, the threads which the weavers shoot across with an instrument called the shuttle.

WOOL, the covering of sheep. Each fleece consists of wool of several qualities and degrees of fineness, which the dealers therein take care to separate.

The fineness and plenty of our wool is owing, in a great measure, to the short sweet grass in many of our pastures and downs; though the advantage of our sheep feeding on this grass all the year, without being obliged to be shut up under cover during the winter, or to secure them from wolves at other times, contributes not a little to it.

This substance, the material of such important manufactures, possesses some curious chemical properties, none of which however are much illustrated by the various operations performed on it in manufacture, almost all (that of dyeing excepted) being purely mechanical processes. Some of the simple chemical properties of wool have been examined by M Achard, and compared with the corresponding properties of the hair of different animals. The copious generation of oxalic acid by treatment of wool with nitric acid, has been particularly described and explained by M. Bertholet in his beautiful researches on animal matter; and the great solvent power of the caustic fixed alkalies, has been happily applied to some use by M. Chaptal, as a saponaceous compound.

Wool, in the state in which it is taken from the sheep, is always mixed with a great deal of dirt and foulness of different kinds, and in particular is strongly imbued with a natural strong smelling grease. These impurities are got rid of by washing, fulling, and combing, by which the wool is rendered remarkably white, soft, clean, light, and springy under the hand. When boiled in water for several hours, in a common vessel, wool is not in any way altered in weight or texture, nor does the water acquire any sensible impregnation.

The action of the nitric acid on wool is very curious. When cold, this acid only disengages a large quantity of azotic gas; but when warmed, much nitrous gas is given out, and at least two new acids are formed, *viz.* the malic and the oxalic, the

latter is in greater abundance than even from sugar and nitrous acid, or any other hydro-carbonous basis. A small scum of a peculiar oil always arises during the action of nitrous acid on these animal substances.

The carbonated alkalies have little action on wool, but the caustic fixed alkalies, when digested with it, speedily weaken its fibre, reduce it to a soft gelatinous pulp, and finally make a perfect solution. The alkali at the same time loses its alkaline properties, as it does in common soap. This saponaceous solution of wool is made for experiment in a few minutes, by boiling bits of wool or flannel in a caustic alkaline solution; and it has been recommended by Chaptal to be employed instead of common soap in cleansing cotton and other goods in manufactures, as by this means a number of refuse bits and clippings of wool and woollen cloth, which are now thrown away, may be put to some use. This soapy solution does not lather well when agitated with water, nevertheless it acts very powerfully in cleaning cloth. It has a strong and somewhat offensive smell, which is left at first in the cloth, but goes off by short exposure to the air.

Wool, either in a raw or manufactured state, has always been the principal of the staple articles of this country. The price of wool was, in very early times, much higher, in proportion to the wages of labour, the rent of land, and the price of butchers' meat, than at present. It was, before the time of Edward III. always exported raw, the art of working it into cloth and dyeing being so imperfectly known, that no persons above the degree of working people could go dressed in cloth of English manufacture.

The first steps taken to encourage the manufacture of woollen cloths was by Edward III., who procured some good workmen from the Netherlands, by means of protection and encouragement. The value of wool was considered as so essentially solid, that taxes were vested in that commodity, reckoning by the number of sacks; and in proportion to the price of the necessaries of life, and value of silver, wool was at least three times dearer then than it is now. The manufacturing of cloth being once introduced into the country, the policy of preventing the exportation of the raw material was soon evident; and the first act was that of Henry IV. c. 2, by which the exportation of sheep, lambs, or rams, is forbidden, under very heavy penalties.

By statute 28 George III. all former statutes respecting the exportation of wool and sheep are repealed, and numerous restrictions are consolidated in that statute. By this act, if any person shall send or receive any sheep on board any vessel, to be carried out of the kingdom, such vessel shall be forfeited, and the person so offending shall forfeit 3*l*. for every sheep, and suffer solitary imprisonment for three months. But wether sheep, by a licence from the collector of the customs, may be taken on board, for the use of the ship's company; and every person who shall export any wool, or woollen articles slightly made up, so as easily to be reduced again to wool, or any fuller's earth, or tobacco-pipe clay; and every carrier, ship owner, commander, mariner, or other person, who shall knowingly assist in exporting, or attempting to export, these articles, shall forfeit 3*s*. for every pound weight, or the sum of 50*l*. in the whole, at the election of the prosecutor, and shall also suffer solitary imprisonment for three months. But wool may be carried coastwise, upon being duly entered, and security being given, according to the directions of the statute, to the officer of the port from whence the same shall be conveyed; and the owners of sheep within five miles of the sea, and ten miles in Kent and Sussex, cannot remove the wool, without giving notice to the officer of the nearest port, as directed by the statute.

Wool *combers*. By 35 George III., c. 124, all those who have served an apprenticeship to the trade of a wool comber, or who are by law entitled to exercise the same, and also their wives and children, may set up and exercise such trade, or any other trade or business they are apt and able for, in any town or place within this kingdom, without any molestation; nor shall such wool combers, their wives or children, while they exercise such trades, be removeable from such place to their last legal settlement, till they shall actually become chargeable to such parish.

WORD, or Watch word, in an army or garrison, is some peculiar word or sentence, by which the soldiers know and distinguish one another in the night, &c. and by which spies and designing persons are discovered. It is used also to prevent surprises. The word is given out, in an army, every night, to the lieutenant, or major-general of the day, who gives it to the majors of the brigades, and they to the adjutants, who give it first to the field offi-

cers, and afterwards to a serjeant of each company, who carry it to the subalterns. In garrisons, it is given, after the gate is shut, to the town-major, who gives it to adjutants, and they to the serjeants.

WORDS. As we proposed, in PHILOSOPHY, *mental*, § 104, we shall lay before our readers a view of Hartley's very important principles, respecting some of the leading phenomena of the understanding; and we beg to refer our readers to UNDERSTANDING, for another branch of those phenomena. These principles illustrate and apply the doctrine of association; and we deem it certain, that the philosophy of language can be pursued with complete success, only by those who have closely attended, practically, if not theoretically, to the influence of that ever active principle.

Words may be considered in four lights: first, as impressions upon the ear; secondly, as the actions of the organs of speech; thirdly, as impressions made upon the eye by characters; fourthly, as the actions of the hand in writing. We learn the use of them in this order; for children first get an imperfect knowledge of the meaning of the words of others; then learn to speak themselves; then to read; and, lastly, to write. Now it is evident, that in the first of these ways, many sensible impressions, and external feelings, are associated with particular words and phrases, so as to give these the power of raising the corresponding ideas; and that the three following ways increase and improve this power, with some additions to the ideas and variations of them. The second is the reverse of the first, the fourth of the third. The first ascertains the ideas belonging to words and phrases in a gross manner, according to their usage in common life. The second fixes this, and makes it ready and accurate. The third has the same effect as the second; and also extends the ideas and significations of words and phrases, by new associations, and in particular, by associations with other words, as in definitions, descriptions, &c. The fourth, by converting the reader into a writer, helps him to be expert in distinguishing, quick in recollecting, and faithful in retaining, these new significations of words. The action of the hand is not, indeed, an essential in this fourth method; composition by persons born blind having nearly the same effect; it is, however, a common attendant on composition, and has a considerable use deducible from association, at the same time making the analogy between the four methods more conspicuous and complete.

Hence it appears, that words and phrases must excite ideas in us by association; and it further appears, that they can do it by no other means, since all the ideas which any word excites are deducible from some of the sources above mentioned, most usually from the first or third: and because words of unknown languages, terms of art not yet explained, barbarous words, &c. have either no ideas connected with them, or only such as some fancied resemblance, or prior association, suggests. It deserves to be remarked, that articulate sounds are, by their variety, number, and ready use, peculiarly fitted to signify and suggest, by association, both our simple ideas, and our complex ones formed from them.

We now proceed to describe the manner in which ideas are associated with words, beginning with childhood.

First, then, the association of the names of visible objects, with the impressions which these objects make upon the eye, seems to take place more early than any other, and to be effected in the following manner. The name of the visible object, the mother, for instance, is pronounced and repeated by the attendants to the child, more frequently when his eye is fixed upon his mother, than when upon any other objects, and much more so than when upon any particular one. The word *mamma* is also sounded in an emphatical manner, when the child's eye is directed to his mother with earnestness and desire. The association, therefore, of the sound, mamma, with the visible impression of the mother on the retina, will be far stronger than that with any other visible impression, and thus overpower all the other accidental associations; and these will also themselves contribute to the same end, by opposing one another. And when the child has acquired so much voluntary power over his motions, as to direct his head and eyes towards the nurse, upon hearing her name, this process will go on with accelerated velocity: and thus, at last, the word will excite the visible idea readily and certainly. The same association of the visible impression of the mother with the sound, mamma, will, by degrees, overpower all the accidental associations of this visible impression with other words; and, at last, be so closely confirmed, that the visible impression will excite the audible idea of the word. This, however, is not to our pre-

sent purpose, but it is a process which takes place at the same time with the other, and contributes to illustrate and confirm it. Both together furnish a complete instance of one of the classes of connections. (§ 21.)

Secondly, this association of words with visible appearances, being made under many particular circumstances, must affect the visible ideas with a like particularity. Thus the mother's dress, and the situation of the fire in the child's nursery, make part of the child's ideas of his mother and fire. But then, as his mother often changes her dress, and the child often sees a fire in a different place, and surrounded by different visible objects, these opposite associations must be less strong than the part which is common to them all; and consequently we may suppose, that while his idea of that part which is common, and which we may call essential, continues the same, that of the particularities, circumstances, and adjuncts, varies.

Thirdly, when the visible objects impress other vivid sensations besides those of sight, such as pleasant or unpleasant tastes, smells, warmth, or coldness, &c. with sufficient frequency, these must have relicts or ideas, (§ 7), which will be associated with the visible ideas of the objects, and with the names of the objects, so as to depend upon them. Thus, an idea of the taste of the mother's milk will rise up in the mind of the child, on his hearing her name; and hence the whole idea belonging to the word mamma now begins to be complex, consisting of two sets of ideas derived from different senses; and these ideas will be associated together, not only because the same word raises both, but also because the original sensations were often received together. The stronger idea will therefore assist the weaker. Now, in common cases, visible ideas are the strongest; or, at least, occur the most readily; but in this case it appears to be otherwise. It would be easy to proceed to various other and more complex cases, in which the component ideas are united, and all made to depend on the respective names of visible objects; but what has been said is sufficient to show what ideas the names of visible objects, proper and appellative, raise in us.

Fourthly, we must, however, observe, respecting appellatives, that sometimes the idea is the common compound result of all the sensible impressions received from several of the objects comprised under the general appellation; sometimes, in a great measure at least, the particular idea of some one of these, namely, when the impressions arising from some one of the class are more frequent and vivid than those of the rest.

Fifthly, the names denoting sensible qualities, whether substantive or adjective, such as whiteness, white, &c. get their ideas in a manner which will be easily understood from what has been already stated. That visible impression which is common to all objects which have been frequently seen having the name, white, applied to them, becomes the leading feature of the ideas belonging to them; and the word excites that most vividly and universally, while it excites only faintly, or at least with great variation, the ideas of the peculiarities, circumstances, and adjuncts: and so of the other sensible qualities.

Sixthly, the names of visible actions, as walking, &c. raise the proper visible ideas by a like process. Other ideas may likewise adhere in certain cases, as in those of tasting, feeling, speaking, &c. Sensible impressions, in which no visible action is concerned, may also have ideas dependant upon words. However, some visible ideas generally intermix themselves here. These actions and perceptions are generally denoted by verbs, though sometimes by substantives.

Seventhly, as children may learn to read words, not only in an elementary way, *viz.* by learning the letters and syllables of which they are composed, but also in a summary one, *viz.* by associating the sound of entire words with their visible representations; and must, in some cases, be taught in this latter method, that is, while the sound of the word deviates from that of its elements; so both children and adults often learn the ideas belonging to whole sentences, in a summary way, and not by adding together the ideas of the several words in the sentence. And wherever words occur, which, separately taken, have no distinct proper ideas, their use can be learned in no other way than this; and this will be the case where the words are extremely general, applying to a vast variety of visible objects, and to circumstances and relations which are not obvious to the uncultivated mind. Now, pronouns, and particles, and many other words, are of this sort. Thus, I walk, is associated at different times with the same visible impressions with, mamma walks, brother walks, &c. and therefore can for a long time suggest nothing permanently but the action of walking. However, the pronoun, *I*,

in this and innumerable other short sentences, being always associated with the person speaking, (as *thou* with the person spoken to, and *he* with the person spoken of), the frequent recurrency of this teaches the child the use of the pronouns; that is, teaches him what difference he is to expect in his sensible impressions, according as this or that pronoun is used; the vast number of instances making up for the very small quantity of information which each, singly taken, conveys. In like manner different particles, (that is, adverbs, conjunctions, and prepositions), being used in sentences where the substantives, adjectives, and verbs, are the same; and the same particles, when these are different, in an endless recurrency, teach children the use of the particles in a gross general way. For it may be observed, that children are much at a loss for the true use of the pronouns and particles for some years; and that they often repeat the proper name of the person instead of the pronoun; which confirms the foregoing reasoning.

Eighthly, the attempts which children make to express their own wants, perceptions, pains, &c. in words, and the corrections and suggestions of the attendants, are of the greatest use in all the steps that we have hitherto considered, and especially in the last, respecting the particles and pronouns.

Ninthly, learning to read helps children much in the same respects; especially as it teaches them to separate sentences into the several words which compose them; which those who cannot read are scarcely able to do, even when they arrive at adult age.

Thus we may see how children and others are enabled to understand a continued discourse, relating to sensible impressions only; and how the words, in passing over the ear, must raise up trains of visible and other ideas, by the power of association. Our next inquiry must be concerning the words which denote either intellectual things, or collections of other words.

Tenthly, the words which relate to the several passions of love, hatred, hope, fear, anger, &c. being applied to the child when he is under the influence of these passions, get the power of raising up the ideas of those passions, and also the usual associated circumstances. The application of the same words to others helps also to annex the ideas of the associated circumstances to them, and even of the passions themselves, both from the infectiousness of our natures, and from the power of associated circumstances to raise the passions. The words, however, denoting the passions, do not, for the most part, raise up in us any degree of the passions themselves, but only the ideas of the associated circumstances. We are supposed sufficiently to understand the continued discourses into which these words enter, when we form true notions of the actions, particularly the visible ones, attending the feelings denoted.

Eleventhly, the names of intellectual and moral qualities and operations, stand for a description of these qualities and operations; and therefore, if dwelt upon, excite such ideas as these descriptions in all their particular circumstances do. But the common sentences into which these words enter, pass over the mind too quick, for the most part, to allow of such delay. They are acknowledged as familiar and correct; and suggest certain associated visible ideas, and nascent internal feelings, taken from the description of these names, or from the words which are usually joined with them in discourses and writings.

Twelfthly, there are many terms of art in all the branches of learning, which are defined by other words, and which, therefore, are only compendious substitutes for them. The same holds in common life in numberless instances. Such words sometimes suggest the words of their definitions, sometimes the ideas of these words, sometimes a particular species comprehended under the general term, &c. But whatever they suggest, it may be easily seen, that they derive the power of doing it from association.

Lastly, there are words used in abstract sciences which can scarcely be defined or described by other words, such as *identity*, *existence*, &c. The use of these must therefore be learned, as that of the particles is. Indeed children learn their first imperfect notions of all the words considered in this and the last three paragraphs, chiefly in this way; and come to more precise and explicit ones only by means of books, as they advance to adult age, or by endeavouring to use them properly in their own deliberate compositions.

From the foregoing train of reasoning, the following inferences may be drawn.

1. Including under the head of definition, description, or any way of explaining a word by other words, excepting that by a mere synonymous term; and

excluding from the head of ideas the visible idea of the character of a word, and the audible one of its sound, and also all ideas which are either extremely faint or extremely variable; words may be distinguished into the four following classes: 1. Such as have ideas only; 2. Such as have both ideas and definitions; 3. Such as have definitions only; 4. Such as have neither ideas nor definitions.

It is difficult to fix precise limits to these four classes, so as to determine accurately where each ends and the next begins; and if we consider these things in the most general way, there is perhaps no word which has not both an idea and a definition; that is, which is not occasionally attended with some one or more internal feelings, and which may not be explained, in some imperfect manner at least, by other words. However, the following are some instances of words which have the fairest right to each class. The names of simple sensible objects are of the first class. Thus *white*, *sweet*, &c. excite ideas, but cannot be defined. Words of this class stand only for the stable parts of the respective ideas, not for the several variable particularities, circumstances, and adjuncts, which here intermix themselves.

The names of natural bodies, animal, vegetable, or mineral, are of the second class; for they excite aggregates of sensible ideas, and at the same time may be defined by an enumeration of their properties and characteristics. Thus likewise geometrical figures have both ideas and definitions. The definitions, in both cases, are so contrived as to leave out all the variable particularities of the ideas, and also to be more full and precise than the ideas generally are in the parts which are of a permanent nature.

Algebraic quantities, such as roots, powers, surds, &c. belong to the third class; and have definitions only. The same may be said of scientifical terms of art, and of most abstract general terms, moral, metaphysical, and vulgar. However, mental emotions are apt to attend some of these even in passing slightly over the ear, and these emotions may be considered as ideas belonging to the respective terms. Thus the very words, *gratitude*, *mercy*, *cruelty*, *treachery*, &c. separately taken, affect the mind; and yet, since all reasoning upon them is to be founded on their definitions, it seems best to refer them to this third class.

Lastly, the particles, *the*, *of*, *to*, *for*, *but*, &c. have neither definition nor ideas, as we have limited those terms.

2. It will easily appear, from the observations here made upon words, and the associations which adhere to them, that the languages of different ages and nations must bear a great general resemblance to each other, and yet have considerable particular differences; whence any one may be translated into any other, so as to convey the same ideas in general, and yet not with perfect precision and exactness. They must resemble one another, because the phenomena of nature which they are all intended to express, and the uses and exigencies of human life to which they minister, have a general resemblance. But then, as the bodily make and genius of each people, the air, soil, and climate, commerce, arts, sciences, religion, &c. make considerable differences in different ages and nations, it is natural to expect that the languages should have proportionable differences in respect of each other.

In learning a new language, the words of it are at first substitutes for those of our native language; that is, they are associated, by means of these, with the proper objects and ideas. When this association is sufficiently strong, the middle bond is dropped, and the words of the new language become substitutes for, and suggest directly and immediately objects and ideas; also clusters of other words in the same language.

In learning a new language, it is much easier to translate from it into the native one, than back again; just as young children are much better able to understand the expressions of others, than to express their own conceptions. And the reason is the same in both cases. Young children learn at first to go from the words of others, and those who learn a new language, from the words of that language to the things signified. And the reverse of this, *viz.* to go from the things signified to the words, must be difficult for a time, from the nature of successive associations. It is to be added here, that the nature and connections of the things signified often determine the import of sentences, though their grammatical analysis is not understood; and that we suppose the person who attempts to translate from a new language, is sufficiently expert in passing from the things signified to the corresponding words of his own language. The power of association is every where conspicuous in these remarks.

3. It follows also from the foregoing reasoning, that persons who speak the same language cannot always mean the same things by the same words, but must

sometimes mistake each other's meaning. This confusion and uncertainty arise from the different associations transferred upon the same words by the difference in the accidents and events of our lives. It is, however, much more common in discourses concerning abstract matters, where the terms stand for collections of other terms, sometimes at the pleasure of the speaker or writer, than in the common and necessary affairs of life; for here frequent use, and the constancy of the phenomena of nature, intended to be expressed by words, have rendered their sense determinate and certain. However, it seems possible, and even not very difficult, for two truly candid and intelligent persons to understand each other upon any subject.

That we may enter more particularly into the causes of this confusion, and consequently be the better enabled to prevent it, let us consider words according to the four classes above mentioned.

Now, mistakes will happen in words of the first class, *viz.* such as have ideas only, where the persons have associated these words with different impressions. And the method to rectify any mistake of this kind is, for each person to show with what actual impressions he has associated the word in question. But mistakes here are not common.

In words of the second class, *viz.* such as have both ideas and definitions, it often happens that one person's knowledge is much more full than another's, and consequently his idea and definition much more extensive. This must cause a misapprehension on one side, which yet may be easily rectified by recurring to the definition. It happens also sometimes in words of this class, that a man's ideas are not always suitable to his definition; that is, are not the same with those which the words of the definition would excite. If then this person should pretend, or even design, to reason from his definition, and yet reason from his idea, misapprehension will arise in the hearer, who supposes him to reason from his definition merely.

In words of the third class, which have definitions only and no immediate ideas, mistakes generally arise through want of fixed definitions being mutually acknowledged and kept to. However, as imperfect fluctuating ideas that have little relation to the definitions, are often apt to adhere to the words of this class, mistakes must arise from this cause also.

As to the words of the fourth class, or those which have neither ideas nor definitions, it is easy to ascertain their use by inserting them in sentences where import is known and acknowledged, this being the method in which children learn to decypher them; so that mistakes could not arise in the words of this class, did we use moderate care and candour. And, indeed, since children learn the uses of words most evidently without having any data, any fixed point at all, it is to be hoped that philosophers and candid persons may learn at least to understand one another with facility and certainty; and get to the very bottom of the connection between words and ideas.

4. When words have acquired any considerable power of exciting pleasant or painful feelings, by being often associated with such things as do this, they may transfer a part of their pleasures and pains upon indifferent things, by being at other times often associated with such. This is one of the principal sources of the several factitious pleasures and pains of human life. Thus, to give an instance from childhood, the words *sweet*, *good*, *pretty*, *fine*, &c. on the one hand; and the words *bad*, *ugly*, *frightful*, &c. on the other, being applied by the nurse and attendants in the child's hearing, almost promiscuously, and without those restrictions that are observed in correct speaking; the one set to all the pleasures, the other to all the pains, of the several senses, must by association raise up general pleasant and painful feelings, in which no one part can be distinguished above the rest; and when applied by further associations to objects of a neutral kind, they must transfer a general pleasure or pain upon them.

5. Since words thus collect ideas from various quarters, unite them together, and transfer them, both upon other words and upon foreign objects, it is evident that the use of words adds much to the number and complexity of our ideas, and is the principal means by which we make mental and moral improvement. This is verified abundantly by the observations which are made upon persons born deaf, and continuing so. It is probable, however, that these persons make use of some symbols to assist the memory, and fix the imagination; and they must have a great variety of pleasures and pains transferred upon visible objects, from their associations with one another, and with sensible pleasures of all kinds; but they are very deficient in this, upon the whole, through the want of the associa-

tions of visible objects and states of mind, &c. with words. Learning to read must add greatly to their mental improvement; yet still their intellectual capacities cannot but remain very narrow.

Persons blind from birth must proceed in a manner different from that before described, in the first ideas which they affix to words. As the visible ones are wanting, the others, particularly the tangible and audible ones, must compose the aggregates which are annexed to words. However, as they are capable of learning and retaining as great a variety of words as others, and can associate with them pleasures and pains from the four remaining senses, they fall little or nothing short of others in intellectual accomplishments, and may arrive even at a greater degree of spirituality and abstraction in their complex ideas.

6. Hence it follows, that when children, or others, first learn to read, the view of the words excites ideas only by the mediation of their sounds, with which alone their ideas have hitherto been associated. And thus it is that children and illiterate persons best understand what they read by reading aloud. By degrees, the intermediate links being left out, the written or printed characters suggest the ideas directly and instantaneously; so that persons who are much in the habit of reading, understand more readily by passing over the words with the eye only; since this method, by being more expeditious, brings the ideas closer together. However, all are peculiarly affected by words pronounced in a manner suitable to their sense and design; which is still an associated influence.

WORKING, *in harvest*. A person may go abroad to work in harvest, carrying with him a certificate from the minister, and one churchwarden, or overseer, that he hath a dwelling-house or place, in which he inhabits, and hath left wife and children, or some of them there, (or otherwise as his condition shall require) and declaring him an inhabitant there.

WORMS. See Vermes.

Worm, in gunnery, a screw of iron, to to be fixed on the end of a rammer, to pull out the wad of a firelock, carabine, or pistol, being the same with the wad-hook, only the one is more proper for small arms, and the other for cannon.

Worm, in chemistry, is a long, winding, pewter pipe, placed in a tub of water, to cool and condense the vapours in the distillation of spirits.

Worm, a cable or hawser, in the sea language, is to strengthen it by winding a small line, or rope, all along between the strands.

WORSTED, a kind of woollen thread, which, in the spinning, is twisted harder than ordinary. It is chiefly used either wove or knit into stockings, caps, gloves, or the like.

WREATH, in heraldry, a roll of fine linen or silk (like that of a Turkish turban) consisting of the colours borne in the escutcheon, placed in an atchievement between the helmet and the crest, and immediately supporting the crest.

WRECK, such goods as, after a shipwreck, are cast upon the land by the sea, and left there within some county; for they are not wrecks so long as they remain at sea, being within the jurisdiction of the Admiralty.

Various statutes have been made relative to wreck, which was formerly a perquisite belonging to the King, or by special grant to the lord of the manor. It is now, however, held, that if proof can be made of the property of any of the goods or lading which come to shore, they shall not be forfeited as wreck.

By the 3 Edward, c. 4. the sheriff of the county shall be bound to keep the goods a year and a day; that if any man can prove a property in them, either in his own right, or by right of representation, they shall be restored to him without delay.

By statute 26 George II. c. 19, plundering any vessel, either in distress or wrecked, and whether any living creature be on board or not, or preventing the escape of any person that endeavours to save his life, or putting out false lights to bring any vessel into danger, are all declared to be capital felonies; and by this statute, pilfering any goods cast ashore, is declared to be petty larceny. See Insurance *salvage*.

WREN (Sir Christopher,) in biography, a great philosopher and mathematician, and one of the most learned and eminent architects of his age, was the son of the Rev. Christopher Wren, Dean of Windsor, and was born at Knoyle, in Wiltshire, in 1632. He studied at Wadham College, Oxford, where he took the degree of Master of Arts, in 1653, and was chosen fellow of All Souls College there. Soon after he became one of that ingenious and learned society, who then met at Oxford for the improvement of natural and experimental philosophy, and which at length produced the Royal Society.

When very young, he discovered a surprising genius for the mathematics, in which science he made great advances before he was sixteen years of age. In 1657 he was made professor of astronomy in Gresham College, London; and his lectures, which were much frequented, tended greatly to the promotion of real knowledge. He proposed several methods by which to account for the shadows returning backward ten degrees on the dial of King Ahaz, by the laws of nature. One subject of his lectures was upon telescopes, to the improvement of which he had greatly contributed: another was on certain properties of the air, and the barometer. In the year 1658 he read a description of the body and different phases of the planet Saturn; which subject he proposed to investigate, while his colleague, Mr. Rook, then professor of geometry, was carrying on his observations upon the satellites of Jupiter. The same year he communicated some demonstrations concerning cycloids to Dr. Wallis, which were afterwards published by the Doctor at the end of his treatise upon that subject. About that time also he resolved the problem proposed by Pascal, under the feigned name of John de Montford, to all the English mathematicians; and returned another to the mathematicians in France, formerly proposed by Kepler, and then resolved likewise by himself, to which they never gave any solution. In 1660, he invented a method for the construction of solar eclipses; and in the latter part of the same year, he, with ten other gentlemen, formed themselves into a society, to meet weekly, for the improvement of natural and experimental philosophy; being the foundation of the Royal Society. In the beginning of 1661, he was chosen Savilian professor of astronomy at Oxford, in the room of Dr. Seth Ward; where he was the same year created Doctor of Laws.

Among his other accomplishments, Dr. Wren had gained so considerable a skill in architecture, that he was sent for the same year from Oxford, by order of King Charles the Second, to assist Sir John Denham, surveyor-general of the works. In 1663 he was chosen fellow of the Royal Society, being one of those who were first appointed by the council after the grant of their charter. Not long after, it being expected that the King would make the Society a visit, the Lord Brounker, then president, by a letter, requested the advice of Dr. Wren, concerning the experiments which might be most proper on that occasion: to whom the Doctor recommended principally the Torricellian experiment, and the weather needle, as being not mere amusements, but useful, and also neat in their operation.

In 1665 he travelled into France, to examine the most beautiful edifices, and curious mechanical works there, when he made many useful observations. Upon his return home, he was appointed architect, and one of the commissioners for repairing St. Paul's cathedral. Within a few days after the fire of London, 1666, he drew a plan for a new city, and presented it to the King; but it was not approved by the Parliament. In this model the chief streets were to cross each other at right angles, with lesser streets between them; the churches, public buildings, &c. so disposed as not to interfere with the streets, and four piazzas placed at proper distances. Upon the death of Sir John Denham, in 1668, he succeeded him in the office of surveyor-general of the King's works, and from this time he had the direction of a great many public edifices, by which he acquired the highest reputation. He built the magnificent theatre at Oxford, St. Paul's cathedral, the Monument, the modern part of Hampton Court, Chelsea College, one of the wings of Greenwich Hospital, the churches of St. Stephen Walbrook, and St. Mary-le-Bow, with upwards of sixty other churches and public works, which that dreadful fire made necessary. In the management of which business he was assisted in the measurements, and laying out of private property, by the ingenious Dr. Robert Hook. The variety of business in which he was by this means engaged requiring his constant attendance and concern, he resigned his Savilian professorship at Oxford in 1673, and the year following he received from the King the honour of knighthood. He was one of the commissioners who, on the motion of Sir Jonas Moore, surveyor-general of the ordnance, had been appointed to find out a proper place for erecting an observatory, and he proposed Greenwich, which was approved of; the foundation-stone of which was laid the tenth of August, 1675, and the building was presently finished, under the direction of Sir Jonas, with the advice and assistance of Sir Christopher.

In 1680 he was chosen president of the Royal Society; afterwards appointed architect and commissioner of Chelsea College; and in 1684, principal officer or comptroller of the works in Windsor castle. Sir Christopher sat twice in Par-

liament, as a representative for two different boroughs. While he continued surveyer-general, his residence was in Scotland-yard; but after his removal from that office, in 1718, he lived in St. James's street, Westminster. He died the twenty-fifth of February, 1723, at ninety-one years of age; and he was interred with great solemnity in St. Paul's Cathedral, in the vault under the south wing of the choir, near the east end.

WRIGHT (EDWARD,) in biography, a noted English mathematician, who flourished in the latter part of the sixteenth century, and beginning of the seventeenth. He was contemporary with Mr. Briggs, and much concerned with him in the business of the logarithms, the short time they were published before his death. He also contributed greatly to the improvement of navigation and astronomy. He was the first undertaker of that difficult but useful work, by which a little river is brought from the town of Ware in a new canal, to supply the City of London with water; but by the manœuvres of others he was hindered from completing the work he had begun. For the improvement of the art of navigation he was appointed mathematical lecturer by the East India Company, and read lectures in the house of that worthy knight, Sir Thomas Smith, for which he had a yearly salary of fifty pounds. This office he discharged with great reputation, and much to the satisfaction of his hearers. He published in English a book on the Doctrine of the Sphere, which is very scarce and dear, and another concerning the construction of sun-dials. He also prefixed an ingenious preface to the learned Gilbert's book on the load-stone. He published other works, and died in the year 1615.

WRIT is the King's precept, whereby any thing is commanded touching a suit or action; as the defendant or tenant to be summoned, a distress to be taken, a disseisin to be redressed, &c. And these writs are diversely divided; some, in respect of their order or manner of granting, are termed original, and some judicial. Original writs are those that are sent out for the summoning of the defendant in a personal, or the tenant in a real action, before the suit begins, or rather to begin the suit.

The judicial writs are those which are sent out by order of the court, where the cause depends, upon occasion, after the suit begins.

Original writs are issued out of the Court of Chancery, for the summoning a defendant to appear, and are granted before the suit is begun, to begin the same: and judicial writs issue out of the court where the original is returned, after the suit is begun. The originals bear date in the name of the King, but the judicial writs bear teste in the name of the chief justice.

WRIT *of inquiry of damages*, a judicial writ that issues out to the sheriff, upon a judgment by default, in action of the case, covenant, trespass, trover, &c. commanding him to summon a jury to inquire what damages the plaintiff hath sustained *occasione præmissorum;* and when this is returned with the inquisition, the rule for judgment is given upon it, and if nothing be said to the contrary, judgment is thereupon entered.

A writ of inquiry of damages is a mere inquest of office, to inform the conscience of the court; who, if they please, may themselves assess the damages. And it is accordingly the practice in actions upon promissory notes and bills of exchange, instead of executing a writ of inquiry, to apply to the court for a rule to show cause why it should not be referred to the master, to see what is due for principal and interest, and why final judgment should not be signed for that sum, without executing a writ of inquiry: which rule is made absolute on an affidavit of service, unless good cause be shown to the contrary.

WRITER *of the tallies*, an officer of the Exchequer, being clerk to the auditor of the receipt, who writes, upon the tallies, the whole letters of the teller's bill. See the articles TALLY, EXCHEQUER, &c.

WRITING, *origin of alphabetical.* The history of the origin and progress of written languages is, in most of its stages, less enveloped in obscurity than that of oral language. Difficulties attend it in common with every inquiry into antiquity; but the data are more numerous and progressive than the fleeting nature of audible signs would admit. The rudiments of the art of writing are very simple; its advances towards the present state of improvement, slow and gradual. Visible language first used marks as the signs of things; and we can trace it through all its stages, from the simple picture, to the arbitrary mark for the elements of sound.

The rudest species of visible communication was, the variously coloured knotted cords of the Peruvians, called the quipos. They have been represented by

some authors as regular annals of the empire; but they might have some significancy by agreement; it is probable that without oral interpretation they would denote nothing more than that something was to be remembered, like the twelve stones in Joshua, iv. 21, 22. Robertson, with more probability, supposes that they were a device for rendering calculation more expeditious and accurate; that by the various colours, different objects were denoted; and by each knot a distinct number. This is rendered still more probable by the circumstance, that picture-writing was used by the Peruvians; and, as the names of numbers must be denoted by arbitrary signs to render calculation at all extensive, this species of arbitrary sign might be more convenient for their rude arithmetic than any other.

Picture-writing, such as was adopted by the Mexicans, is the first step of the progress towards letter-writing. The simplest species was a mere delineation of the object to be denoted. Thus the North American Indians, when they went to war, painted some trees with the figures of warriors, often of the exact number of the party; and if they went by water, they delineated a canoe. Thus, too, the Mexicans, at the arrival of the Spaniards, sent large paintings on cloth as dispatches to Montezuma. The Mexicans had made some progress beyond simple delineations; but of these their paintings are principally composed, and by a proper disposition of their figures, they could exhibit a more complex series of events in historical order. Some very curious specimens of this picture-writing are preserved: the most valuable one has been published, and may be found in Purchas's "Pilgrim," or in Thevenot's "Collection of Voyages." It is divided into three parts: the first is a history of the Mexican Empire; the second is a tribute-roll; and the third, a code of their institutions.

The defects of this mode of communication must have been early felt. Where applicable, it was tedious, and was confined to objects of sense. The human intellect, stimulated by the necessity of improvement, would have proceeded through the same course in the New World as in the Old; but a stop was put to this progress by the destruction of the most cultivated empires. Picture writing, then the simple hieroglyphic, then the symbolical hieroglyphic, then the arbitrary character for words, and, lastly, for letters, was the evident progress of the mind. The Mexicans had actually, in some instances, passed through all the intermediate stages; though the short duration of their empire prevented them from extending these rudiments to a regular system. In the simple hieroglyphic, the principal part or circumstance of a subject is placed for the whole. In the historical painting before mentioned, towns are uniformly denoted by the rude delineation of a house, to which was added some distinguishing emblem: these emblems were denotements of their names, which were generally significant compounds. Kings and generals were in like manner denoted by heads of men, with similar emblematic marks conjoined. They also used the symbolical hieroglyphic to denote a conqueror: they placed a target with darts between the characters, for the king, and the cities which he had subdued. Their marks for months and other portions of time, for the air, the earth, &c. were symbolical; and their cyphers are arbitrary characters: they painted as many small circles as there were units to 20, which had its proper mark; by the successive addition of these marks, they denoted numbers to 20 times 20, or 400, which again had its proper mark; then by the successive addition of these, they denoted as far as 20 times 400, or 8000, which had a new character. Whatever their advances, however, annals so conveyed must have been very imperfect; and accordingly they took great pains to instruct the young to supply the deficiencies, and to remove the ambiguities, by means of traditionary explanations. See Robertson's "America," vol. iii. p. 173—180; from whom, and Clavigero, this account is derived.

Picture-writing and its contraction, which is denominated the simple hieroglyphic, must be very inadequate for the purposes of communication. The figurative hieroglyphic would soon be adopted; for oral language must have made some progress, before the use of permanent visible communication would be found necessary, and, consequently, must have given metaphorical meanings to the names of sensible objects. We here speak of hieroglyphics as intended for the purposes of *communicating*, not of *concealing* knowledge. It was long thought that the latter was the first and only purpose. Warburton has proved that this was not their first use, but that which was made of them in a later period, particularly

when the invention of letters had rendered the former purpose unnecessary. The simple hieroglyphic was, where the delineation of part of the object or action represented the whole. Thus the ancient Egyptians painted a man's two feet in water, to denote a fuller; smoke ascending, to denote fire; two hands, one holding a buckler, the other a bow, to denote a battle. The figurative hieroglyphic was of two kinds: one, where the instrument, real or supposed, was used to denote the performer, or the thing performed: the other, where one object was used to represent another, which had some real or supposed resemblance to it. Egyptian examples of the first kind are, an eye and a sceptre, to signify a king; a sword, a bloody tyrant; the mouth, to denote speech or voice; the sun and moon, as a symbol for succession of time; an eye placed in an eminent position, for the omniscience of God. Examples of the second are, a dog's head (as among the Chinese, a dog's voice), to denote sorrow; dew falling from heaven to denote science. To these may be added, as a mixed example, the inscription on the temple of Minerva at Sais; where are found, engraved on the vestibule, the figures of an infant, an old man, a hawk and a fish, and a river horse; the hawk and fish were the symbol for hatred, and the river horse for impudence: so that the literal translation would be, "young and old hate impudence," or still more literally, "old man, infant, hatred, impudence." The Scythian king sent to Darius, a mouse, a frog, a bird, a dart, and a plough: if he had sent their delineations, it would have formed a similar specimen of the hieroglyphic.

Hieroglyphics would frequently be founded on the figures to which use had given currency in oral language. The procedure of the mind is the same in both; and they would mutually influence each other. With respect to the simple hieroglyphic, as that was a mere contraction of the full delineation in picture-writing, the only similarity we must expect to find in language is the contraction of words. Both were intended for the purpose of facilitating communication, by increasing its rapidity.

The first use of hieroglyphics was, to preserve the memory of events and institutions; such symbols, therefore, would first be adopted as were of obvious interpretation; *viz.* those which were founded on prevailing opinions; as, the hyena, for a man bearing his distresses with fortitude, and rising superior to them, because the skin of that animal was supposed to render the wearer dauntless and invulnerable; on those founded on oral language, which would be intelligible, when the analogies which gave rise to them were forgotten. By degrees they were employed for the more refined purposes of philosophy; and the analogies on which they were founded, would require an acquaintance with the sciences from which they were deduced. Still nothing was done for concealment: at last superstition appropriated their use; and after the invention of letters, they were employed to keep the mysteries of the priesthood from the eyes of the profane vulgar. Their symbols were now formed of far-fetched resemblances; a cat was used to denote the moon, from the supposed contraction or dilatation of the pupil of her eye, at different parts of the lunation. In common hieroglyphics, Egypt was denoted by a crocodile; in the sacred, by a heart on a burning censor. One animal, or other sensible object, was used to denote a variety of qualities; and the same idea was denoted by various hieroglyphics. This has attached to the whole hieroglyphical system the character of mystery: when we trace the progress of the Chinese language, we shall have additional proofs of the injustice of this opinion.

The exact manner of delineation would be tedious and voluminous. The more use was made of visible communication, the more we may expect to find the character, originally significant, become a mere arbitrary mark. In the early stages of the Egyptian hieroglyphics, considerable attention was paid to the outline and filling up of their figures. Afterwards a rude outline was sufficient; and this was changed, for the convenience of the writer, till it lost every resemblance to the object it originally represented. Many changes in our own written character might be adduced, illustrative of this change from the delineation to the cursive hieroglyphic. The mark for *and*, for instance, was once the correct picture of *et*; some forms show its origin, as *&*; at present, in writing at least, it bears no features of resemblanae to its original. The use of the cursive hieroglyphic would take off the attention from the symbol, and fix it upon the thing signified: a progress which we equally observe in oral language, where words, originally denotements of sensible objects, became the names for mental qualities

bearing some resemblance to what they before signified, and in many instances have been appropriated to the mental quality, without any reference to the original meaning.

Visible characters having become arbitrary marks for ideas or words, two processes were pursued by different districts of Asia and Africa: the one was, to consider these characters as signs for sounds, and, by their intervention, of ideas; the other, as signs for ideas without any reference to sounds. The latter was the procedure of the Chinese; the former, of all nations who used alphabetical characters.

On the Chinese Language.

We come now to the consideration of a language singular in all its parts, and possessed of such peculiar features that it well deserves our attention. The written language of the Chinese has passed through all the gradations which we have described: and from their pictures, characters have become mere arbitrary marks; these are employed, not as signs for sounds, but for ideas; and their combinations and changes have no corresponding combinations and changes in the spoken language of China. Before the time of their first emperor, Fohi, the Chinese are supposed to have employed knotted cords, like the Peruvians. Fohi introduced in their place horizontal lines; (see Plate Miscel. fig. 14.) some whole, others divided; and by their combination in threes, formed the text of the most ancient Chinese work, called "Ye King." On these trigrams numerous commentaries have been written, some as early as 1100 years before Christ: they are supposed to contain, in a few lines, the most sublime truths, and are employed in divination; but they are still unintelligible. By Xin-nung, the successor of Fohi, sixty-four hexagrams (like those in fig. 15), were invented, which are supposed to contain the whole circle of human knowledge. It is thought that these characters were taken from the knotted cords, and it seems to us probable that they expressed no more. The time of their invention (which is carried back to the age of Noah), and their apparent inadequacy to represent more than numbers, renders it highly improbable that they were intended to denote the mysteries of philosophy. The present numerals of the Chinese have an equal right to be esteemed the mysterious denotements of science. Whatever be the justness of this idea, it is certain that these trigrams and hexagrams are not the origin of the present Chinese character. In numerous instances, the progress can be traced from pictures or symbols to the present form; in some the connecting steps are lost, but the general inference is still a just one. The present form seldom presents any traces of its original. Tien (fig. 16), heaven, has no longer a natural or symbolical resemblance to the object; but it was first represented by three curved lines (as in fig. 17), and, through the various changes in fig 18, it has arrived at its present form. Several other examples are given in the Philos. Trans. vol. lix.

Before we advance further respecting the written language of the Chinese, it will be proper to attend a little to their oral language. This, as was observed in Language, is entirely monosyllabic; and all the words may be expressed by an European consonant and a vowel, with the exception of about one-third, which end with *n*, either simple or nasal. A monosyllabic language cannot be copious; and we expect to find it less so when the number of simple sounds are small. The Chinese have not the *b*, *d*, and *r*, of the Europeans; and the number of their words is only 330. The capabilities of their oral language are, however, much extended by the variation their words undergo, by means of tone and other inflexions of the voice. These changes require a very discriminating ear to perceive, and very flexible organs to express them; but we know the power of habit, and can readily admit that thus the meaning of their words may be extended, without confusion, even to things very opposite in their nature. When, however, we find (as Hagar informs us), that the same word often answers to six hundred different significations, according to the tone with which it is pronounced, the place which it occupies, or the character by which it is expressed, we must suppose it impossible to avoid frequent ambiguity.

Notwithstanding, however, all their changes in tone, &c. they have not more than 1,500 distinct sounds. Most nations have improved their oral languages; the Chinese have directed all their attention to the improvement of their written language, and they have formed combinations in their characters without any corresponding combinations in their sounds. Their changes are totally inde-

pendent of each other; and the former are understood, where the sounds corresponding to them are different from those of the Chinese. In this respect they may be compared to the arithmetical cyphers, &c. The character for *tsai*, calamity, is an example of this independent combination; it is composed of *mien*, a house, and *bo*, fire. Our process is to join the oral words expressing the ideas we wish to combine; and we should use *mienbo*. We cannot easily and fully enter into this independency of character or sound, because all our words are more or less pictures of sound, and are so strongly associated with sound, that it is difficult to separate them completely, even in imagination. The Chinese, on the other hand, have no immediate connection between their words and their characters, so that it cannot be necessary in using their characters, to use the sounds at all.

All the Chinese characters are composed of 214 clefs or keys. These represent the most obvious and simple ideas; and by their combinations are produced expressions for the more refined and complex ideas. All these clefs were probably simple paintings, or symbols, and hence the whole written language may be fairly considered as deducible from the more obvious writing of the Mexicans and Egyptians. Indeed the resemblance between the ancient Chinese characters and the Egyptian hieroglyphics is so striking, and this in cases where the analogy on which both were founded is not an obvious one, that De Guignes considers them as certainly derived from the same source. These keys are at present formed from six simple strokes; a horizontal line, two perpendicular (the one pointed, the other blunt at bottom) a point, a line curved to the right, and another to the left. The greater part of the keys have from two to seven strokes; six only of one, and some have sixteen or seventeen. We are not however to suppose that the inventors of the Chinese characters fixed upon these six elements, and composed from them methodically. As the characters lost their correctness of delineation, the object was to faciliate the labour of writing. Art by degrees reduced all the characters to the simple strokes we have mentioned.

These keys are either employed alone as a character serving to express an idea; or differently combined in a group, forming a phrase expressive of the idea it is intended to communicate. Thus the character for night is composed of three characters; one signifying darkness, another the action of covering, the third signifying man, which, rendered literally, signifies darkness covering man; a phrase perfectly expressive, and similar to the language of poetry. Both in fact issued "from the cradle of the human race." Figurative language of this kind is much employed in the scriptures: we admire it; for it "comes home to our business and our bosoms." It paints to our minds, and calls up their conceptions forcibly and correctly. Hence, though the offspring of necessity, it is justly esteemed a beauty, and wherever the language of feeling is employed, will generally be found a prevailing trait.

We might suppose that, all the characters being thus composed, nothing more would be necessary, in order to understand them, than to know the elementary characters; but the analogy on which the composition is formed is often extremely obscure, and often erroneous. Their ancient principles of philosophy furnished wide scope for combination; but these were generally ill founded. Other combinations acquire a knowledge of their ancient customs and popular superstitions. Hence the ease which we should in theory expect in understanding a language so regularly formed vanishes; and an acquaintance with their whole round of physical and religious dogmata, with the fleeting customs and opinions of preceding ages, is necessary for a thorough acquaintance with the Chinese characters. This is not, however, entirely peculiar to the Chinese language. In order to trace the origin of words, the same references are often necessary; but we have more frequently the requisite data. *Candidate* signifies a person who offers himself to fill a lucrative or honourable situation; the original meaning of the Latin *Candidatus* is a person dressed in white. The two ideas seem to have no connection. The difficulty vanishes, however, when we learn that among the Romans all candidates wore white robes. In a similar manner we see no connection between running, and wrapping up the feet; but *pao*, the Chinese character for *run*, is composed of two, one for the act of wrapping, the other for feet. The probable connection is ascertained by the circumstance, that the savages of Louisiana, when about to undertake long marches, wrap up their feet to prevent their being torn.

In the Chinese dictionaries the keys are placed in an invariable order, which soon becomes familiar to the student. The

different compounds each follow one another according to the number of strokes of which each consists. The meaning and pronunciation are given by means of two words in common use. When no one common word expresses the exact sound, it is communicated by two connected, with marks to show that the consonant of the first word and the vowel of the second, joined together, form the precise sound wanting. Thus, to express the sound *pien*, *pa* and *mien* would be joined, with marks to denote the elision of the *a* and the *m*.

If the spoken language be scanty, this is not the defect of the written language. Their characters amount to 80,000. A considerable part of them, however, may be considered as synonima; thus age may be expressed by a hundred different characters, and happiness may be traced into as many forms in expressing the general wish for it. Different sects have their own characters; so that when a proper allowance is made, about 10,000 are sufficient for reading the best books of each literary period of their language. In alphabetical writing words may be read without the least knowledge of their meaning; in the hieroglyphical, the sound is less intimately connected with the visible sign, and the character is studied and best learned by becoming acquainted with the ideas attached to it. But the terms of philosophy have been formed on that philosophy, so that a knowledge of the latter is necessary to a complete acquaintance with the former. These ideas we must call to mind when we hear that their most learned men are not acquainted with more than half of them. The knowledge of the whole round of Chinese science and literature must surely be sufficient to occupy the life of the longest liver.

Transition to Letters.

Upon the principle that we ought not to suppose divine interposition, merely from the difficulty of accounting for a phenomenon, we should argue *à priori* that no divine interposition took place in the origin of alphabetical writing. As, however, some presumptive arguments in favour of the affirmative side of the question have been advanced by men of the first eminence, we shall state the most important of them, and after endeavouring to lessen the difficulty they may present to our admission of the human origin of letters, we shall point out what appears to be the most probable account of their invention.

1. It is urged that in order to give any plausibility to the hypothesis of the human invention of letters, it must be shown to be simple. Now if it were simple and obvious, it is highly probable that we should find instances of independent invention. But the fact is, that alphabetical writing may be traced to one source.

Two answers may be given to this argument. First. There is such a great dissimilarity among the Asiatic alphabets, that they cannot be proved to have issued from the same source. It must, however, be remarked, that the variations which we know to have taken place in numerous instances would destroy the force of any objection that might occur from this decided dissimilarity, if positive arguments were adduced to establish their identity of origin. But though these are apparently sufficient to render it probable, yet this probability is not great enough to give much weight to the argument in question. But even admitting its certainty, we may observe, secondly, that this can prove no more than the high antiquity of the invention. That it originated before mankind were much separated from each other; and that the groundwork, laid by those who had made the greatest advances in cultivation, was built upon in different ways by those who afterwards penetrated to the remoter parts of the Continent. But it is urged,

2. That we not only have no instance of independent discovery, but have even the example of a nation which had no communication with those among whom it was first known, remaining in total ignorance of it, and employing a procedure which now incapacitates them for the adoption of alphabetical writing. And the force of this objection is materially increased by the circumstance, that their writing, equally with the alphabetical, originated in the hieroglyphics, and actually went through the same stages, *viz.* from the simple picture to the arbitrary mark. The grand weight of the controversy appears to rest here. The difficulty this argument presents, may probably be obviated by the following considerations:

First, The written language of China was cultivated more for the purposes of literature and philosophy than for those of common life; the combinations were formed by the literati, and it probably would not have been in their power to

have carried these combinations into the oral language of the vulgar. They might indeed have invented an oral language corresponding to their characters; but the genius of the Chinese seems rather to direct them to study than to conversation. In order to render probable a transition from hieroglyphics to letters, we must suppose the spoken and the written language to have been connected with each other, and to have had similar combinations. Now we may observe,

Secondly, That the spoken language of China did not at all favour the plan of making their characters representative of sound, for being all monosyllables, and not very numerous, there would not be the same call for attention to the elementary sounds; and what would still more prevent this direction of the attention, they did not vary the articulation but the tone, in order to express a variation of meaning. Add to this,

Thirdly, The great extent of the empire of China and its dependencies, would cause a great variety in the dialect. This would contribute to increase the attention of their literati to their written language, since this (as we have seen it actually is) might be understood independently of their words.

Fourthly, If we admit the very probable hypothesis of De Guignes, that the Chinese characters were brought from Egypt, and that they had originally no connection with the spoken language of the country into which they were imported;—that, in fact, they were applied to denote names different from those with which they had been before connected;—we shall perceive at once the reason why the combinations of the characters were originally unaccompanied with corresponding combinations of sounds. After this there is no difficulty in admitting that the written must continue independent of the spoken language, especially among people so little addicted to innovation as the Chinese.

3. It is urged that the invention of letters is ascribed to the gods by several of the ancients; that Pliny asserts the use of letters to have been eternal; and that the Jewish doctors maintain that God created alphabetical writing.

We say, in reply, that the Jews had no other records than our own. The ancients were accustomed to ascribe to a divine origin every thing for which they could not account. As for Pliny, he expressly says, that the Phenicians were famed as the inventors of letters.

It must be remarked that these facts are adduced to prove that no records of the invention remain; indirectly, therefore, they favour the hypothesis of the divine origin of letters. If, however, the transition were simple and gradual, perhaps the era of invention could not have been fixed even by the nation in which it occurred. We have no more reason to expect records of the invention of letters than of the Egyptian hieroglyphics, or of the Chinese characters.

The arguments *à priori* for the divine origin of letters, remain to be considered. These are, the difficulty of the invention in any stage of human progress, and its antiquity, which very much increases the improbability of its human origin.

1. As to the difficulty of the invention, it is urged that we are to suppose that the inventors of letters decomposed the sounds of words not only into syllables, but into letters; that observing the component parts of syllables, and denoting them by appropriate marks, they used these marks for those elementary sounds in the visible representation of other words into which those sounds entered. This dissection of the articulate sounds of man, tracing them through all their various combinations, and denoting them by a few simple marks, whose combinations might express every possible combination of sound, supposes a habit of patient experimenting, of discriminating examination, and of exact classification, which ill accord with the uncultivated state of human intellect in the early period of society. But,

2. When we consider the antiquity of the use of letters, and find them in a state of perfection so early as the time of Moses, this difficulty appears insuperable. We must admit that men, in the earliest ages, stepped at once from a tedious and awkward, and frequently unintelligible mode of communication, to one which answers every purpose in the shortest way, and that, unlike all other inventions, it was brought at once to such a state of perfection, that no succeeding alphabet has any real superiority over the ancient Hebrew.

With respect to the difficulty of the invention, the objection loses all its force when a simple and easy procedure, probable in the given circumstances, can be pointed out. To obviate the difficulty arising from the apparent perfection of

the most ancient alphabets, we may observe,

First, That in a perfect alphabet every letter should represent only one definite sound, and every known sound in the given language should have a corresponding letter. Now we have no instance of a perfect alphabet among modern languages, and have therefore no reason to suppose that the first alphabet was perfect. But even admitting that some of the ancient alphabets which have been transmitted to us were perfect, yet it must be observed,

Secondly, That no known alphabet, however ancient, is in the state of its original invention. Cadmus, who was born in the east, carried with him into Greece sixteen letters only; the least copious alphabet we are acquainted with has twenty-two. It is not probable that Cadmus introduced fewer than he possessed; it is more probable that he invented new ones to express sounds which he found among the aborigines.

It has generally been supposed of late, that alphabetical writing was formed from hieroglyphics; but we have met with no one, except De Guignes, who has stated the steps of the transition in a satisfactory manner. "Perhaps," says this writer, "we have done too much honour to the inventor of letters, whoever he were, in supposing that he dissected the voice into two parts, and invented marks of two kinds, some to represent consonants, and others vowels."

The following is, with some variations, the hypothesis of this writer. Hieroglyphics, with their exactness of delineation, lost their original significancy. This must first be the case with words of most frequent recurrence, and which entered most into combinations with other words; become simple denotements of sound, they were employed to express their respective sounds in combinations of other monosyllabic words, which, in like manner, had lost their original significancy. Hence, by degrees, they became representative of the component parts of all words into which their respective sounds entered. They were always words, but very simple, consisting only of a consonant and a vowel. Variation in the pronunciation of the vowel would occur in different dialects, and hence these marks would be regarded as consonants capable of being differently modified by simple vocal sounds. Letters, at first monosyllabic words, then became marks for the component parts of dissyllabic or polysyllabic words; and then for the unchangeable part of those syllables, that is, for consonants. In the most ancient state of the oriental languages, vowel sounds had no distinct marks. In the latter, marks were joined to the consonants to express the different sounds with which the radical consonant was invested. Among the western nations, a different procedure was adopted. In some cases they used the mark which they had received from the oriental nations for an aspirate and vowel, for the vowel itself; and having once commenced the use of distinct marks for vowels, the procedure was continued, and new marks adopted to express noticed variations of vocal sounds.

In support of this statement, may be adduced the following observations:

1. We have seen that hieroglyphics did become significant of sounds; and (see Language) that words, originally significant of one class of ideas, being applied to a second, lost their connection with the former, and became directly significant of the latter.

2. We have reason to believe that words were originally monosyllabic in those nations where alphabetical writing was invented, and that the combination of old sounds, or the use of them, uncompounded to express new ideas, was the mode employed to extend the capabilities of their language. Hence the same word would frequently occur in combination, and though its different significations must originally have been represented by different hieroglyphics, yet, as these lost their significancy, they would easily become as extensive in their meaning as the sounds themselves. And it is obvious that the most simple of those hieroglyphics which were used for the same sound, would be employed to represent the sound.

3. It has been shown to be highly probable, that originally every consonant had its vowel sound. Hence all syllables might be represented by two, or at most three, European letters. This circumstance would materially diminish the varieties of syllabic sounds.

4. The probability of the theory advanced depends greatly upon the hypothesis, that originally letters were syllabic. The following facts appear to prove this: The ancient oriental alphabets had no denotements for vowels, and even if this be disputed, it must be admitted that they had many words into which none of the supposed vowel marks entered. The

Ethiopian alphabet is entirely syllabic. The simple letters denote a consonant and a short *a*, and marks were added to them to denote other vowels where used. What is doubly singular, they have in many cases added marks to these syllabic characters, to denote they have no vowel belonging to them. In the Coptic and Arabic there are syllabic characters. The alphabets of the eastern Asiatics are principally syllabic, some with ŏ, others with ă, joined to a consonant. These circumstances render probable the account here given of the transition from hieroglyphics to letters. The following observations more completely ascertain its high probability.

5. The letters of some of the ancient alphabets have so great a resemblance to the hieroglyphical characters; indeed are such exact transcripts of them, that a simple inspection is sufficient to convince us that hieroglyphics were the origin of letters. This, however, proves little as to the invention of alphabetical writing, except that it was subsequent to the use of hieroglyphics. But,

6. These characters, in many instances, retained their original significancy, which proves them to have been, as De Guignes supposes, denotements for words. We must not expect to find this significancy in all words of which they form component parts; but in such only in whose visible representation the original hieroglyphic formed a component part. Now we must observe, first, that the names of several of the oriental letters are still by themselves significant, and that some of these letters are similar to the Chinese clefs, which have the same signification. Thus the י *yod* signifies the *hand.* Its form, in some alphabets, resembles the Chinese character for *hand.* The ד *daleth* of the Hebrews, Phenicians, and Ethiopians, signifies *a gate,* and the action of opening. The hieroglyphic which among the ancient Chinese represented *a gate,* is exactly similar to this letter. The פ *phi* of the Hebrews and *af* of the Ethiopians signify the *mouth.* The Chinese characters for the *mouth* all resemble it. The ע *ain* signifies the *eye.* The Phenicians and the Chinese employed the outline of the eye as a denotement of the object. The ש *shin* in Hebrews signifies the *teeth,* and its figure is still found among the Chinese with the same signification. The מ *mim* signifies *water.* The corresponding Samaritan and Ethiopian characters have a strong resemblance to the Chinese hieroglyphic for water. Lastly, the א *aleph* (originally perhaps signifying *ox*) signifies *unity,* the *action of conducting, pre-eminence.* The Phenician form of this exactly represents the Chinese character for *one,* and *every action by which we are at the head of others.* But these letters are not only significant by themselves, but secondly in combinations. Thus י was expressed by the monosyllable *ya, ye,* or *you*; to this another monosyllable, which had equally a signification relative to the figure, being added, formed a word of two syllables. For instance, instead of the present denomination of ד *daleth,* we may reasonably suppose its original sound to have been *da.* The word יד *yada,* hieroglyphically represented by *a gate* and *a hand,* is found in the Hebrew with a signification derived from that of the letters composing it; to *cast out* (as we might say, *hand* him to the *door*), to *extend.* Add to this the word ע *ain* (originally probably sounded *ho*), which signifies the *eye,* and we have *yadaho,* which should signify to *open the eyes,* to *extend the view,* &c. and metaphorically, to *know,* to *understand*; and, in fact, this is the signification of ידע in Hebrew. But this is not all, for exactly the same procedure has been adopted by the Chinese. *Ki,* which signifies to *examine,* is composed of three radical characters, of which the first signifies *the hand,* the second *a gate,* the third *the eye.* So also *kia* is composed of three characters, one signifying the *teeth,* the other two, *gate* or *opening,* which signifies to *break through,* to *make a great opening.* In Hebrew שדד is similarly composed. It signifies to *plunder,* to *lay waste.* *Tchi* is a large collection of water. It was composed of the characters for *hand* and *water.* The same compound was formed among the Hebrews, and ים *yam,* signifies a *great collection of water,* or *the sea.* In Arabic the letters *thet* or *earth,* and *mim* or *water,* from the word *tham,* and signify a *flood.* The Hebrew *thin* is composed of the *thet* or *earth,* and the *nun,* which signifies *man, i. e. man of the earth,* and further, to *form,* to *create.* In both these instances, the Chinese correspond in their combinations with the alphabetical writing. Many other instances might be brought. We will adduce one to which there is no corresponding combination in the Chinese language. *Ab,* or *Haba,* אב, signifies father. The component parts of it signify *principal of the house.*

The papers of De Guignes, to which we are very greatly indebted on this sub-

ject, are to be found in Memoires de l'Academie des Inscriptions et des Belles Lettres, vol. 34, &c.

WRONG *stamp*. By 37 George III. c. 136. any instrument (except bills of exchange, promissory notes, or other notes, drafts, or orders) liable to stamp-duty, whereon shall be impressed any stamp of a different denomination, but of an equal or greater value than the stamp required, may be stamped with the proper stamp after the execution, on payment of duty and five pounds penalty, but without any allowance for the wrong stamp.

Likewise any such instrument (except as aforesaid) being ingrossed without having been first stamped, or having a stamp thereon of less value than required, the same may be stamped after the execution, on payment of the duty and ten pounds penalty only, for each skin thereof: but in case it shall be satisfactorily proved to the Commissioners of stamps, that the same hath been so ingrossed either by accident or inadvertency, or from urgent necessity, or unavoidable circumstances, and without any intention of fraud, the Commissioners are authorized to stamp the same within sixty days after the execution, to remit the penalty in part, or in all, and to indemnify persons so ingrossing the same.

WULFENIA, in botany, so named from the Rev. Francis Xavier Wulfen, a genus of the Diandria Monogynia class and order. Essential character: corolla tubular, ringent, with the upper lip short, entire, the lower three-parted, with the aperture bearded; calyx five-parted; capsule two-celled, four-valved. There is only one species, *viz.* W. carinthiaca, a native of Carinthia, on the highest Alps.

WURMBEA, in botany, so named in honour of Frederick Baron Van Wurmb, a genus of the Hexandria Trigynia class and order. Natural order of Coronariæ. Junci, Jussieu. Essential character: calyx none; corolla six-parted, with a hexangular tube; filaments inserted into the throat. There are three species.

WYTE, or WITE, in our ancient customs, a pecuniary penalty or mulct. The Saxons had two kinds of punishments, *were* and *wyte;* the first for the more grievous offences. The wyte was for the less heinous ones. It was not fixed to any certain sum, but left at liberty to be varied according to the nature of the case. Hence also wyte, or wittree, one of the terms of privilege granted to our sportsmen, signifying a freedom or immunity from fines or amerciaments.

X.

X, or *x*, is the twenty-second letter of our alphabet, and a double consonant. It was not used by the Hebrews or ancient Greeks; for as it is a compound letter, the ancients, who used great simplicity in their writings, made use of, and expressed this letter by its component letters *cs*. Neither have the Italians this letter, but express it by *ss*. X begins no word in our language but such as are of Greek original, and is in few others but what are of Latin derivation, as *perplex*, *reflexion*, *defluxion*, &c. We often express this sound by single letters, as *cks* in *backs*, *necks;* by *ks* in *books*, *breaks;* by *cc* in *access*, *accident;* by *ct* in *action*, *unction*, &c. In numerals it expresses 10, whence in old Rom. n manuscrips it is used for *denarius;* and as such seems to be made of two V's placed one over the other. When a dash is added over it, thus $\overline{X}$, it signifies ten thousand.

XANTHE, in botany, a genus of the Dioecia Syngenesia class and order. Essential character: flowers dioecious; calyx five, six-parted, permanent; corolla five, six-petalled; males with one filament, bearing five anthers, collected into a shield-shaped head; females with five barren anthers; capsule globose, crowned with the stigma, five-striated, five-valved; seeds very many, involved in the pulp. There are two species, *viz.* X. quapoya, and X. panari.

XANTHIUM, in botany, a genus of the Monoecia Pentandria class and order. Natural order of Compositæ Nucamentaceæ. Corymbiferæ, Jussieu. Essential charac-

ter: male, calyx common, imbricate; corolla one petalled; five-cleft, funnel-form; receptacle chaffy; female, calyx involucre, two-leaved, two-flowered; corolla none; drupe dry, muricated, two cleft; nucleus two-celled. There are five species.

XANTHORHIZA, in botany, a genus of the Pentandria Polygynia class and order. Natural order of Ranunculaceæ, Jussieu. Essential character: calyx none; petals five; nectary five, pedicelled; capsule five, one-seeded. There is only one species, *viz.* X. apiifolia, a native of North America.

XANTHOXYLUM, in botany, a genus of the Dioecia Pentandria class and order. Natural order of Hederaceæ. Terebintaceæ, Jussieu. Essential character: calyx five-parted; corolla none; female, pistil five; capsule five, one-seeded. There is but one species, *viz.* X. clava herculis, tooth-ache tree; it grows naturally in Pennsylvania and Maryland.

XERANTHEMUM, in botany, a genus of the Syngenesia Polygamia Superflua class and order. Natural order of Compositæ Discoideæ. Corymbiferæ, Jussieu. Essential character: calyx imbricate, rayed, with the ray coloured; down bristle-shaped; receptacle chaffy. There are twenty-seven species.

XIMENIA, in botany, so named in honour of the Rev. Father Francis Ximenes, a Spaniard, a genus of the Octandria Monogynia class and order. Natural order of Aurantia, Jussieu. Essential character: calyx four-cleft; petals four, hairy, rolled back; drupe one-seeded. There are three species.

XIPHIAS, the *sword-fish,* in natural history, a genus of fishes of the order Apodes. Generic character: head with the upper jaw ending in a sword-shaped snout; mouth without teeth; gill-membrane eight-rayed; body roundish, without scales. There are three species; X. gladeus, or the common sword-fish, is of the length of twenty feet, and is particularly distinguished by its upper jaw being stretched to a considerable distance beyond the lower, flat above and beneath, but edges at the sides, and of a bony substance, covered by a strong epidermis. It is a fish extremely rapacious, and finds in the above instrument a weapon of attack and destruction able to procure it the most ample supplies. It first transfixes its prey with this snout, and then devours it. It is found in the Mediterranean, chiefly about Sicily, and is used as food by the Sicilians, who preserve it for a long time by salting it in small pieces. See Pisces, Plate VI. fig. 5.

X. platypterus, or the broad-finned sword-fish, is found in the Northern, Atlantic, and Indian Seas, and is considered as one of the most fatal enemies of the whale tribe. Its strength is so great, that it is said to have pervaded with its snout, or sword, the plank of an East Indiaman; and a plank and snout in attestation of this circumstance, the latter closely driven into the former, are to be seen in the British Museum, having been communicated to Sir Joseph Banks by an East India Captain, of honour and veracity. When young this fish is used for food, but not after it exceeds four or five feet in length.

XIPHIDIUM, in botany, a genus of the Triandria Monogynia class and order. Natural order of Ensatæ, Irides, Jussieu. Essential character: corolla six-petalled, equal; capsule superior, three-celled, many-seeded. There are two species, *viz.* X. album and X. cæruleum.

XYLOCARPUS, in botany, a genus of the Octandria Monogynia class and order. Essential character: calyx four-toothed; corolla four-petalled; nectary eight-cleft; filaments inserted into the nectary: drupe juiceless, large, four or five-grooved; nuts eight or ten, difform. There is but one species, *viz.* X. granatum, a native of the East Indies.

XYLOMELUM, in botany, a genus of the Tetrandria Monogynia class and order. Natural order of Proteæ, Jussieu. Essential character: ament with a simple scale; petals four, staminiferous; stigma club-shaped. obtuse. This is one of twenty new genera from the South Seas: the characters of which are given by Dr. Smith.

XYLON. See Gossypium.

XYLOPHYLLA, in botany, *sea-side laurel,* a genus of the Pentandria Trigynia class and order. Natural order of Tricoccæ. Euphorbiæ, Jussieu. Essential character: calyx five-parted, coloured; corolla none; stigmas jagged; capsule three-celled; seeds two. There are seven species.

XYLOPIA, in botany, *bitter-wood,* a genus of the Polyandria Polygynia class and order. Natural order of Coadunatæ. Anonæ, Jussieu. Essential character: calyx three-leaved; petals six; capsule one or two-seeded, four-cornered, two-valved; seeds arilled. There are three species.

XYLOSMA, in botany, a genus of the Dioecia Polyandria class and order. Essential character: calyx four or five-parted; corolla none, but a small annular crenulate nectary surrounding the sta-

mens: male, stamens twenty to fifty; female, style scarcely any; stigma trifid; berry dry, subbilocular; seeds two, three-sided. There are two species, *viz.* X. suaveolens and X. orbiculatum.

XYRIS, in botany, a genus of the Triandria Monogynia class and order. Natural order of Ensatæ. Junci, Jussieu. Essential character: corolla three-petalled, equal, crenate; glumes, two-valved in a head; capsule superior. There are four species.

Y.

Y, Or y, the twenty-third letter of our alphabet: its sound is formed by expressing the breath with a sudden expansion of the lips from that configuration by by which we express the vowel *u*. It is a consonant in the beginning of words, and placed before all vowels, as in *yard, yield, young*, &c. but before no consonant. At the end of words it is a vowel, and is substituted for the sound of *i*, as in *try, descry*, &c. In the middle of words it is not used so frequently as *i* is, unless in words derived from the Greek, as in *chyle, empyreal*, &c. though it is admitted into the middle of some pure English words, as in *dying, flying*, &c. Y is also a numeral, signifying 150, or, according to Baronius, 159; and with a dash a-top, as $\overline{Y}$, it signified 150,000.

YACHT, or Yatch, a vessel with one deck, carrying from four to twelve guns.

YARD, a measure of length used in England and Spain, chiefly to measure cloth, stuffs, &c. See Measure.

Yard *land* is taken to signify a certain quantity of land, in some counties being fifteen acres, and in others twenty; in some twenty-four, and in others thirty and forty acres.

Yards *of a ship*, are those long pieces of timber which are made a little tapering at each end, and are fitted each athwart its proper mast, with the sails made fast to them, so as to be hoisted up, or lowered down, as occasion serves. They have their names from the masts to which they belong.

There are several sea terms relating to the management of the yards; as, square the yards; that is, see that they hang right across the ship, and no yard-arm traversed more than another: top the yards; that is, make them stand even. To top the main and fore yards, the clew-lines are the most proper; but when the top-sails are stowed, then the top-sail-sheets will top them.

Yard *arm* is that half of the yard that is on either side of the mast, when it lies athwart the ship.

Yards also denotes places belonging to the navy, where the ships of war, &c. are laid up in harbour. There are, belonging to his Majesty's navy, six great yards, *viz.* Chatham, Deptford, Woolwich, Portsmouth, Sheerness, and Plymouth; these yards are fitted with several docks, wharfs, launches, and graving places, for the building, repairing, and cleaning of his Majesty's ships; and therein are lodged great quantities of timber, masts, planks, anchors, and other materials: there are also convenient store-houses in each yard, in which are laid up vast quantities of cables, rigging, sails, blocks, and all other sorts of stores, needful for the royal navy.

YARE, among sailors, implies ready or quick; as, be yare at the helm; that is, be quick, ready, and expeditious at the helm. It is sometimes also used for bright by seamen: as, to keep his arms yare; that is, to keep them clean and bright.

YARN, wool or flax spun into thread, of which they weave cloth.

YEAR, the time that the sun takes to go through the twelve signs of the zodiac. See Chronology.

Year and Day, is a time that determines a right in many cases; and in some works an usurpation, and in others a prescription; as in case of an estray, if the owner, proclamation being made, challenge it not within the time, it is forfeited.

So is the year and day, given in case of appeal; in case of descent after entry or claim; if no claim upon a fine or writ of right at the common law; so if a villain remaining in ancient demesne; of a man

sore bruised or wounded; of protections; essoigns in respect of the King's service; of a wreck, and divers other cases.

Years, *estate for*. Tenant for term of years is, where a man letteth lands or tenements to another, for a certain term of years agreed upon between the lessor and lessee; and when the lessee entereth by force of the lease, then he is tenant for term of years.

If tenements be let to a man for term of half a year, or for a quarter of a year, or any less time, this lessee is respected as tenant for years, and is styled so in some legal proceedings, a year being the shortest term which the law in this case takes notice of.

Generally, every estate which must expire at a period certain and prefixed, by whatever words created, is an estate for years, and therefore this estate is frequently called a term, because its duration or continuance is bounded, limited, and determined. For every such estate must have a certain beginning and certain end. If no day of commencement be named in the creation of this estate, it begins from the making or delivery of the lease. A lease for so many years as such an one shall live, is void from the beginning, for it is neither certain, nor can it ever be reduced to a certainty, during the continuance of the lease. And the same doctrine holds, if a parson make a lease of his glebe for so many years as he shall continue parson of such a church, for this is still more uncertain. But a lease for twenty or more years, if the parson shall so long live, or if he shall so long continue parson, is good; for there is a certain period fixed, beyond which it cannot last, though it may determine sooner, on the parson's death, or his ceasing to be parson there.

An estate for years, though never so many, is inferior to an estate for life. For as estate for life, though it be only for the life of another person, is a freehold; but an estate, though it be for a thousand years, is only a chattel, and reckoned part of the personal estate. For no estate of freehold can commence *in futuro*, because it cannot be created at common law without livery of seisin, or corporal possession of the land; and corporal possession cannot be given of an estate now, which is not to commence now, but hereafter. And because no livery of seisin is necessary for a lease for years, such a lessee is not said to be seised, or to have true legal seisin of the lands. Nor, indeed, doth the bare lease vest any estate in the lessee, but only gives him a right of entry on the tenement, which right is called his interest in the term; but when he has actually so entered, and thereby accepted the grant, the estate is then, and not before, vested in him, and he is possessed, not properly of the land, but of the term of years, the possession or seisin of the land remaining still in him who has the freehold.

YELLOW *earth*, named by Werner, gelberde, is of a yellow ochre colour, of various degrees of intensity. It is massive, soft, and friable: it adheres strongly to the tongue, and feels greasy. It occurs in beds with iron-stone in Upper Saxony, and is employed as a yellow pigment.

Yellow, *Naples*, a fine pigment, so called from the city in which it was long prepared. It has the appearance of an earth, is very friable, heavy, porous, and not altered by exposure to the air. The preparation is kept a secret, but by analysis it is found to be a metallic oxide. A similar pigment may be produced by mixing twelve parts of ceruss; three of diaphoretic antimony, and of alum and sal-ammoniac one part each; heat them for some time to a temperature below redness, and afterwards in a red heat for three hours longer, after which the mass will have acquired a beautiful yellow colour.

YEOMAN, is defined to be one that hath fee land of 40s. a year; who was thereby, heretofore, qualified to serve on juries, and can yet vote for knights of the shire, and do any other act where the law requires one that is *probus et legalis homo*. Below yeomen are ranked tradesmen, artificers, and labourers.

YEST, Yeast, or Barm, a head, or scum rising upon beer or ale, while working or fermenting in the vat. See Brewing, Fermentation, &c.

It is used for a leaven or ferment in the baking of bread, as serving to swell or puff it up very considerably in a little time, and to make it much lighter, softer, and more delicate. When there is too much of it, it renders the bread bitter. See Baking and Bread.

Yeast consists of gluten, sugar, and mucilage, with some alcohol, and a portion of malic, acetic, and carbonic acids; but the essential parts of yeast are gluten mixed with a vegetable acid; and therefore dried yeast, which must have lost some of its component parts, is fit for fermentation equally with that which is fresh and new.

YEW. See TAXUS.

YTTRIA. See ITTRIA.

YUCCA, in botany, *Adam's needle*, a genus of the Hexandria Monogynia class and order. Natural order of Coronariæ. Lilia, Jussieu. Essential character: corolla bell-shaped, spreading; style none; capsule three-celled. There are four species.

YUNX, the *wry-neck*, in natural history, a genus of birds of the order Picæ. Generic character; bill somewhat round, slightly incurvated and weak; nostrils bare and rather concave; tongue long, slender, and armed at the point; tail of ten flexible feathers; feet formed for climbing; toes two before and two behind. There is only one species.

Y. torquilla, or the wry-neck, is allied in some respects to the wood-pecker, and in others to the cuckow. It is about the size of a lark, and its colours, though not glaring, are mingled with extreme neatness, and even elegance. It makes no nest, but lays eight or ten eggs on the bare wood in hollow trees. In England it is a bird of passage, generally appearing about ten days before the cuckow. Its food consists chiefly of ants, which, during incubation, the male may be observed carrying to the female. The young on experiencing any annoyance, utter a hissing noise, which excites the idea of some venomous reptile, and has frequently proved their security from destruction. At the end of summer the wry-neck is extremely plump and fat, and is considered by some as little inferior to the ortolan for the table. It is never seen in flocks, and in pairs only during the spring and summer, after which each individual has its solitary haunt in that country, and withdraws unaccompanied in its flight in its winter migration.

Z.

Z, Or z, the twenty-fourth and last letter, and the nineteenth consonant of our alphabet; the sound of which is formed by a motion of the tongue from the palate downwards, and upwards to it again, with a shutting and opening of the teeth at the same time. This letter has been reputed a double consonant, having the sound *ds*; but some think with very little reason; and, as if we thought otherwise, we often double it, as in *puzzle*, *muzzle*, &c. Among the ancients, Z was a numeral letter, signifying two thousand, and, with a dash added a-top, $\bar{Z}$ signified two thousand times two thousand, or four millions. In abbreviations, this letter formerly stood as a mark for several sorts of weights: sometimes it signified an ounce and a half, and, very frequently, it stood for half an ounce; sometimes for the eighth part of an ounce, or a dram troy weight; and it has, in earlier times, been used to express the third part of one ounce, or eight scruples. ZZ were used by some of the ancient physicians to express myrrh, and at present they are often used to signify zinziber, or ginger.

ZAFFER. See COBALT.

ZAMIA, in botany, a genus of the Appendix Palmæ class and order. Natural order of Palmæ. Filices, Jussieu. Essential character: male, ament strobile-shaped; scales covered with pollen underneath: female, ament strobile-shaped, with scales at each margin; berry solitary. There are five species.

ZANNICHELLIA, in botany, so named in honour of Giov. Jeronymo Zannichelli, a genus of the Monœcia Monandria class and order. Natural order of Inundatæ. Naiades, Jussieu. Essential character: male, calyx none; corolla none: female, calyx one-leafed; corolla none; germs four or more; seeds as many, pedicelled; stigmas peltate. There is only one species, *viz.* Z. palustris, horned pondweed, a native of Europe.

ZANONIA, in botany, so named in memory of Giacomo Zanoni, prefect of the botanic garden at Bologna, a genus of the Dioecia Pentandria class and order. Natural order of Cucurbitaceæ, Jussieu. Essential character: calyx three-leaved; corolla five-parted: female, styles three; berry three-celled, inferior; seeds two in

each cell. There is but one species, *viz.* Z. indica, a native of Malabar.

ZEA, in botany, a genus of the Monoecia Triandria class and order. Natural order of Gramina or Grasses. Essential character: males in distinct spikes; calyx glume two-flowered, awnless; corolla glume two-flowered, awnless: female, calyx glume one-flowered, two-valved; corolla glume four-valved; style one, filiform, pendulous; seeds solitary, immersed in an oblong receptacle. There is but one species, *viz.* Z. mays, Indian corn, or maize, and several varieties. The Indians in New England, and many other parts of America, had no other vegetable but maize, or Indian corn, for making their bread. They call it weachin, and in the United States of America, there is much of the bread of the country made of this grain, not of the European corn. In Italy, Germany, Spain, and Portugal, maize constitutes a great part of the food of the poor inhabitants. The ear of the maize yields a much greater quantity of grain than any of our corn-ears. There are commonly about eight rows of grain in the ear, often more, if the ground is good. Each of these rows contains at least thirty grains, and each of these gives much more flour than a grain of any of our corn. The grains are usually either white or yellowish; but sometimes they are red, bluish, greenish, or olive-coloured, and sometimes striped and variegated. This sort of grain, though so essentially necessary to the natives of the place, is yet liable to many accidents. It does not ripen till the end of September; so that the rains often fall heavy upon it while on the stalk, and birds in general peck it when it is soft and unripe. Nature has, to defend it from these accidents, covered it with a thick husk, which keeps off slight rains very well; but the birds, if not frightened away, often eat through it, and devour a great quantity of the grain.

ZEBRA. See EQUUS.

ZENITH, in astronomy, the vertical point; or a point in the heavens directly over our heads. The zenith is called the pole of the horizon, because it is ninety degrees distant from every point of that circle. See POLE and HORIZON.

ZENITH-*distance* is the complement of the meridian altitude of any heavenly object; or it is the remainder, when the meridian altitude is subtracted from ninety degrees.

ZENO, in biography, a Greek philosopher of considerable eminence, was born in the isle of Cyprus. He was founder of the Stoics, a sect which had its name from that of a portico at Athens, where Zeno was accustomed to deliver his discourses. The father of our philosopher was a merchant, but readily seconded his son's inclinations, and devoted him to the pursuits of literature. In the way of business he had frequent occasion to visit Athens, where he purchased for his son, several of the most renowned works of the celebrated Socratic philosophers. These Zeno read with avidity, and determined to visit the city where so much wisdom was found. Upon his first arrival in Athens, going accidentally into the shop of a bookseller, he took up the commentaries of Xenophon, with the perusal of which he was so much delighted, that he asked the bookseller where he might meet with such men. Crates, the cynic philosopher, was at that moment passing by; the bookseller pointed to him, and said, follow that man. He immediately became his disciple, but was soon dissatisfied with his doctrine, and joined himself to other philosophers, whose instructions were more accordant to his way of thinking. Zeno staid long with no master; he studied under all the most celebrated teachers, with a view of collecting materials from various quarters for a new system of his own. To this Polemo alluded when he saw Zeno coming into his school; "I am no stranger," said he, "to your Phenician arts, I perceive that your design is to creep slily into my garden, and steal away the fruit." From this period Zeno avowed his intention of becoming the founder of a new sect. The place which he chose for his school was the painted porch, the most famous in Athens. Zeno excelled in that kind of subtle reasoning which was in his time very popular. Hence, his followers were very numerous, and from the highest ranks in society. Among these was Antigonus Gonates, king of Macedon, who earnestly solicited him to go to his court He possessed so large a share of esteem among the Athenians, that, on account of his integrity, they deposited the keys of their citadel in his hands; they also honoured him with a golden crown and a statue of brass. He lived to the age of 98, and at last, in consequence of an accident, voluntarily put an end to his life. As he was walking in his school, he fell down and broke his finger, by which, it is said, he was so much affected, that, striking the earth, he exclaimed, "Why am I thus impor-

tuned? I obey thy summons," and immediately went and strangled himself. In morals, the principal difference between the cynics and the stoics was, that the former disdained the cultivation of nature, the latter affected to rise above it. In physics, Zeno received his doctrine from Pythagoras and Heraclitus, through the channel of the Platonic school. See ACADEMIES, CYNICS, &c.

ZEOLITE, in mineralogy, a species of the flint genus, divided into five subspecies, *viz.* the mealy, fibrous, radiated, foliated, and cubic zeolite, distinguished from each other by fracture, hardness, and lustre. The mealy is yellow, or reddish-white, is found in Iceland, Ferro islands, Sweden, and in some parts of Scotland, particularly in the isle of Skye; it consists of

Silica	50
Alumina	20
Lime	8
Water	22
	100

The other sub-species vary in their proportions of the same substances. The cubic intumesces like borax before the blow-pipe, and melts readily into cellular glass, and during fusion emits a phosphoric light. With acid it forms a jelly. It occurs in rocks of the newest floetz trap, (see ROCK) as amygdaloid, basalt, wacce, porphyry, slate, and greenstone. All the different sub-species of zeolite are found in Scotland, and in the neighbouring islands. They are also met with in great perfection and beauty in Iceland, the Ferro islands, and in several parts of Sweden; and in many parts of Germany, and in the East Indies.

ZEUS, the *dory*, in natural history, a genus of fishes of the order Thoracici. Generic character: head compressed, sloping down; upper lip arched by a transverse membrane; tongue in most species subulate; body compressed, broad, somewhat rhomboid, thin, and of a bright colour, gill-membrane with seven perpendicular rays, the lowest transverse; rays of the first dorsal fin filamentous. There are eight species, of which the following are the principal.

Z. faber, or the common dory of Europe, has a large oval dusky spot on each side of the body, and is generally about thirteen inches long, though often far longer, and even weighing ten or twelve pounds. It is found in the Northern, Mediterranean, and Atlantic Seas, is extremely voracious, and subsists on insects, smaller fishes, and ova. It is in the highest estimation for the table in England, but was little used before the middle of the last century. See Pisces, Plate VI. fig. 6.

Z. insidiator, or the insidious dory, inhabits the fresh waters of India, and is distinguished by its mouth being more lengthened than that of any other species The lower lip is said to be at pleasure contracted into a tube, through which this fish darts the fluid it takes in at the gills at various insects near the surface, thus embarrassing their wings, and suspending their flight, under which circumstances they easily become its prey.

ZIERIA, in botany, so named in memory of John Zier, a genus of the Tetrandria Monogynia class and order. Natural order of Rutaceæ, Jussieu. Essential character: calyx four-parted; petals four; stamina smooth, placed on glands; styles simple; stigma four-lobed; capsules four, united; seeds arilled. This is one of the twenty new genera from the South Seas, the characters of which are given by Dr. J. E. Smith. It is distinguished by having each of the stamens inserted into a large gland, and consists of shrubs with opposite, ternate leaves, and white flowers.

ZINC, in chemistry and mineralogy, a metal unknown to the ancients, though they were acquainted with calamine, one of its ores, and the effect which this had in converting copper into brass. Zinc has usually been ranked among those metals, which, from their imperfect ductility and malleability, were long denominated semimetals. It was known, that by uniform pressure zinc might be extended into thin plates, and more lately, it has been discovered, that, at a certain temperature, it has so much malleability and ductility, that it can be lamellated, and drawn into wire. For this invention a patent has been obtained by Messrs. Hobson and Sylvester, to the latter of whom this work has been indebted for certain articles. See the PREFACE.

The temperature at which zinc possesses these properties is between 210° and 300° of Fahrenheit, and by keeping it in an oven at this heat, it may readily be extended. By annealing, it retains this tenacity as to be easily bent. At a higher temperature it is brittle, so as to fall to pieces under the hammer. Zinc is of a white colour, with a shade of blue; in a fresh fracture it is possessed of considera-

ble lustre. It is hard, and not easily cut with a knife. The specific gravity is nearly 7.2. The ores of zinc are calamine and blende. See CALAMINARIS. Calamine is an oxide, frequently with a portion of carbonic acid; blende is a sulphuret, containing also some iron, and other extraneous matters. The ores of zinc are found in many countries, and in a number of mines in this country. The metal is obtained from the ore by distillation.

Zinc is melted by a moderate heat, and the fused mass, on cooling, forms regular crystals. Though scarcely altered by exposure to the air at a low temperature, yet it is rapidly oxydized by one amounting to ignition. When kept in a degree of heat barely sufficient for its fusion, zinc, becomes covered with a grey oxide. But when thrown into a crucible, or deep earthen pot, heated to whiteness, it suddenly inflames, burns with a beautiful white flame, and a white and light oxide sublimes, having a considerable resemblance to carded wool. This oxide, however, when once deposited, is no longer volatile; but, if exposed to a violent heat, runs into glass. Zinc readily dissolves in sulphuric, nitric, and muriatic acids. With nitric acid, it yields nitrous gas, if the acid be concentrated; or nitrous oxide, if diluted. Sulphuric and muriatic acids, diluted with water, evolve, during their action on this metal, hydrogen gas; and the gas, when obtained, holds in combination a portion of the metal. A stream of it has been found, if recently prepared, to occasion the fusion of the platina wire, though the pure gas is destitute of this property. This hydrogen gas, holding zinc in solution, may also be obtained by a process of Vauquelin. A mixture of the ore of zinc, called blende, or calamine, with charcoal, is to be put into a porcelain tube, which is to be placed horizontally in a furnace, and, when red-hot, the vapour of water is to be driven over it. The gas that is produced, however, is a mixture of carbonic acid, carburetted hydrogen, and hydro-zincic gas. The zinc is deposited on the surface of the water, by which this gas is confined; but, if burned when recently prepared, the gas exhibits, in consequence of this impregnation, a blue flame. The solution of zinc in sulphuric acid shoots into regular crystals. This salt is readily soluble, and its solution is not precipitated by any other metal. The muriate of zinc yields, when evaporated, an extract of thick consistence, having the viscidity of birdlime. Zinc is oxydized also, when boiled with solutions of pure alkalies; and a portion of the oxide is retained in solution. It is oxydized when mixed with nitre, and projected into a red-hot crucible. In this case a violent detonation ensues.

Zinc combines with almost all the metals, and some of its alloys are of great importance It may be united to gold in any proportion by fusion. The alloy is the whiter and the more brittle, the greater quantity of zinc it contains. An alloy, consisting of equal parts of these metals, is very hard and white, receives a fine polish, and does not tarnish readily. It has therefore been proposed as very proper for the specula of telescopes. One part of zinc is said to destroy the ductility of one hundred parts of gold. Platinum combines very readily with zinc. The alloy is brittle, pretty hard, very fusible, of a bluish-white colour, and not so clear as that of zinc The alloy of silver and zinc is easily produced by fusion. It is brittle, and has not been applied to any use. Zinc may be combined with mercury, either by triturating the two metals together, or by dropping mercury into melted zinc. This amalgam is solid. It crystallizes when melted, and cooled slowly into lamellated hexagonal figures, with cavities between them. They are composed of one part of zinc, and two and a half of mercury. It is used to rub on electrical machines, in order to excite electricity.

Zinc combines readily with copper, and forms one of the most useful of all the metallic alloys. The metals are usually combined together by stratifying plates of copper, and a native oxide of zinc combined with carbonic acid, called calamine, and applying heat. When the zinc does not exceed a fourth part of the copper, the alloy is known by the name of brass. It is of a beautiful yellow colour, more fusible than copper, and not so apt to tarnish. It is malleable, and so ductile, that it may be drawn out into wire. Its density is greater than the mean. It ought to be by calculation 7.6, but it actually is 8.4 nearly, so that its density is increased by about one-tenth. When the alloy contains three parts of zinc and four of copper, it assumes a colour nearly the same with gold, but it is not so malleable as brass. It is then called pinchbeck, prince's metal, or Prince Rupert's metal. Brass was known, and very much valued, by the ancients. They used an ore of zinc to form it, which they called cadmia. Dr. Watson has proved that it was to brass

that they gave the name of orichalcum. Their æs wass copper, or rather bronze.

It is very difficult to form an alloy of iron and zinc. Malouin has shown that zinc may be used instead of tin to cover iron plates, a proof that there is an affinity between the two metals. Tin and zinc may be easily combined by fusion. The alloy is much harder than zinc, and scarcely less ductile. This alloy is often the principal ingredient in the compound called pewter.

ZINNIA, in botany, so named in honour of John Godofr. Zinn, a genus of the Syngenesia Polygamia Superflua class and order. Natural order of Compositæ Oppositifoliæ. Corymbiferæ, Jussieu. Essential character: calyx ovate, cylindrical, imbricate; florets of the ray five, permanent, entire; seed down, with two erect awns; receptacle chaffy. There are five species.

ZIRCON, in mineralogy, the name of a genus, containing two species, *viz.* hyacinth and zircon: the former will be found in the alphabetical arrangement; we therefore proceed to the species zircon, the chief colour of which is grey; but it occurs through all the varieties of green, blue, red, yellow, and brown. It is found commonly in roundish angular pieces, which have almost always rounded angles and edges. It is likewise crystallized. Specific gravity about 4.6. The constituent parts are, according to Klaproth,

Zirconia	69.0
Silica	26.5
Oxide of iron	0.5
Loss	4.0
	100.0

It is infusible without addition by the blow pipe; with borax it forms a colourless glass. It is found in Ceylon, in the sand of a river, accompanied by crystals of spinelle, tourmaline, ceylanite. It is also found in America; Mr. Solomon Conrad of Philadelphia discovered it near Trenton, New Jersey. It is frequently cut as a precious stone, and employed for various purposes, particularly as an ornament in mourning dress. When it is cut it exhibits, though in a very faint degree, the play of colours of the diamond. Some of the varieties are frequently used by watchmakers in jewelling watches.

ZIZANIA, in botany, a genus of the Monoecia Hexandria class and order. Natural order of Gramina. Gramineæ, Jussieu. Essential character: male, calyx none; corolla glume two-valved, awnless, mixed with the females; female, calyx none; corolla glume two-valved, cowled, awned; style two-parted; seed one, clothed with the plaited corolla. There are two species; *viz.* Z. aquatica, and Z. terrestris.

ZIZIPHORA, in botany, a genus of the Diandria Monogynia class and order. Natural order of Verticillatæ. Libiatæ, Jussieu. Essential character; calyx filiform; corolla ringent, with the upper lip bent back and entire; seeds four. There are four species.

ZODIAC, in astronomy, a broad circle, whose middle is the ecliptic, and its extremes two circles, parallel thereto, at such a distance from it, as to bound or comprehend the excursions of the sun and planets.

The sun never deviates from the middle of the zodiac, *i. e.* from the ecliptic, but the planets all do more or less. Their greatest deviations, called latitudes, are the measure of the breadth of the zodiac, which is broader or narrower, as the greatest latitude of the planets is made more or less; accordingly some make it sixteen, some eighteen, and some twenty degrees broad. The zodiac, cutting the equator obliquely, makes an angle therewith of about 23½°, which is what we call the obliquity of the zodiac, and is the sun's greatest declination.

The zodiac is divided into twelve portions, called signs, and those divisions or signs are denominated from the constellations which anciently possessed each part; but the zodiac being immoveable, and the stars having a motion from west to east, those constellations no longer correspond to their proper signs, whence arises what we call the precession of the equinoxes.

ZOEGEA, in botany, a genus of the Syngenesia Polygamia Frustranea class and order. Natural order of Compositæ Capitatæ. Cinarocephalæ, Jussieu. Essential character: calyx imbricate; corolla of the ray ligulate; down bristle-shaped; receptacle bristly. There is but one species, *viz.* Z. leptaurea, a native of the Levant.

ZOISITE, in mineralogy, is of a greyish colour. It occurs massive, and in crystals, which are imbedded. It occurs in primitive mountains, principally in quartz with mica. This fossil is placed between the axinite and pistazite, and connects both species together.

ZONE, in geography and astronomy,

a division of the terraqueous globe, with respect to the different degrees of heat found in the different parts thereof. A zone is the fifth part of the surface of the earth, contained between two parallels. The zones are denominated torrid, frigid, and temperate. The torrid zone is a band surrounding the terraqueous globe, and terminated by the two tropics. Its breadth is 46° 58′. The equator running through the middle of it, divides it into two equal parts, each containing 23° 29′. The ancients imagined the torrid zone uninhabitable. The temperate zones are two bands, environing the globe, and contained between the tropics and the polar circles: the breadth of each is 43° 2′. The frigid zones are segments of the surface of the earth, terminated, one by the antarctic, and the other by the arctic circle. The breadth of each is 46° 58′.

ZONITES, in natural history, a genus of insects of the order Coleoptera: antennæ testaceous; four feelers filiform; jaw entire, longer than the feelers; lip emarginate. There are eight species, found chiefly in warm countries.

ZOOLOGY, constitutes that branch of natural history which relates to animals. Various methods of arrangement have, by different naturalists, been devised to render this branch of study easy of comprehension, and familiar to the minds of those who wish for a general view of animated nature. We shall, in this article, give an outline of the Linnæan system, which has, in the various departments of the British Encyclopedia, been adopted, as most generally approved by philosophers of all countries.

Linnæus divides the whole animal kingdom into six classes, the characters of which are taken from the internal structure of the being treated of. It may be observed, that a considerable portion of the bulk of animals is composed of tubular vessels, which originate in a heart: the heart propels through the arteries, with the assistance of their own muscular powers, either a colourless transparent fluid, or a red blood, into the extremities of the veins; through which it again returns to the origin of motion. Insects and worms have their circulating fluids a little warmer than the surrounding medium, and in general it is colourless; but insects have legs furnished with joints, and worms have nothing but simple tentacula at most, in place of legs. Fishes have cold red blood, which is exposed to the air contained in water by means of their gills. Amphibia receive the air into their lungs, but their blood is likewise cold, and in both fishes and amphibia the heart has only two regular cavities, while that of animals with warm blood has four. Of the latter, the oviparous are birds, and are generally covered with feathers; the viviparous are either quadrupeds or cetaceous animals, and are furnished with organs for suckling their young. See PHYSIOLOGY.

Each of the classes of animals is subdivided by Linnæus into different orders: for a scientific account of these orders, and also of the classes from whence they spring, the reader is referred to the several heads of the Dictionary in the alphabetical order: and here we shall take a cursory view of the subject, in order to give, in a short compass, a sort of outline of the science.

The first class, denominated Mammalia, from the female's suckling its young, comprehends all viviparous animals with warm blood. These, with very few exceptions, have teeth fixed in their jaw bones; and from the form and number of these teeth, the orders are distinguished, except that of cetaceous fishes, which is known by the fins that are found in the place of feet. The distinctions of the teeth are somewhat minute, but they appear to be connected with the mode of life of the animal, and they are tolerably natural. The first order, Primates, contains man, monkeys, and bats: the second, Bruta; among others, the elephant, the rhinoceros, the ant-eater, and the ornithorynchus, an extraordinary quadruped, lately discovered in New Holland, with a bill like a duck, and sometimes teeth inserted behind it; but there are some suspicions that the animal is oviparous. The order Feræ contains the seal, the dog, the cat, the lion, the tiger, the weasel, and the mole, most of them beasts of prey; the opossum and the kangaroo also belong to this order, and the kangaroo feeds on vegetables, although its teeth are like those of carnivorous animals. The fourth order, Glires, comprehends beavers, mice, squirrels, and hares: the fifth, Pecora, camels, goats, sheep, and horned cattle. The sixth order, Belluæ, contains the horse, the hippopotamus, and the hog. The cetaceous fishes, or whales, form the seventh and last order; they reside in the water, enveloped in a thick clothing of fat, that is, of oily matter, deposited in cells, which enables their blood to retain its temperature, notwithstanding the external contact of a dense medium considerably colder.

Birds are distinguished from quadrupeds by their laying eggs; they are also generally feathered, although some few are rather hairy, and instead of hands or fore-legs, they have wings. Their eggs are covered by a calcareous shell; and they consist of a white, or albumen, which nourishes the chick during incubation, and a yolk, which is so suspended within it, as to preserve the side on which the little rudiment of a chicken is situated, continually uppermost, and next to the mother that is sitting on it. The yolk is, in great measure, received into the abdomen of the chicken a little before the time of its being hatched, and serves for its support, like the milk of a quadruped, and like the cotyledons of young plants, until the system is become sufficiently strong for extracting its own food out of the ordinary nutriment of the species.

Birds are divided, according to the form of their bills, into six orders: Accipitres; as eagles, vultures, and hawks. Picæ; as crows, jackdaws, humming birds, and parrots. Anseres; as ducks, swans, and gulls. Grallæ; as herons, woodcocks, and ostriches. Gallinæ; as peacocks, pheasants, turkies, and common fowls. And, lastly, Passeres; comprehending sparrows, larks, swallows, thrushes, and doves. The Amphibia are in some respects very nearly allied to birds: but their blood is little warmer than the surrounding medium. Their respiration is not necessarily performed in a continual succession of alternations, since the whole of their blood does not pass through the lungs, and the circulation may continue without interruption in other parts, although it may be impeded in these organs for want of the motion of respiration. They are very tenacious of life; it has been asserted on good authority, that some of them have lived many years without food, inclosed in hollow trees, and even in the middle of stones: and they often retain vestiges of life some days after the loss of their hearts. Their eggs are generally covered with a membrane only. They have sometimes an intermediate stage of existence, in which all their parts are not yet developed, as we observe in the tadpole; and in this respect they resemble the class of insects. They are now universally considered as divided into two orders only; Reptilia: as the tortoise, the dragon, or flying lizard, the frog, and the toad; all these have four feet: but the animals which belong to the order Serpentes are without feet. Most of the serpentes are perfectly innocent, but others have fangs, by which they instil a poisonous fluid into the wounds that they make. In England the viper is the only venomous serpent; it is known by its dark brown colour, and by a stripe of whitish spots running along its back; but to mankind its bite is seldom, if ever fatal.

The first three classes of animals have lungs, as we have already seen, for respiration, and receive air by the mouth; those which have gills, and red blood, are fishes, residing either in fresh or in salt water, or indifferently in both: their eggs are involved in a membrane, and have no albumen.

Of the six orders of fishes, four have regular gills, supported by little bones; and they are distinguished according to the place of their ventral fins, into Apodes, as the eel and lamprey: Jugulares, as the cod: Thoracici, as the sole and perch: and Abdominales, as the salmon and pike, distinctions which appear to be perfectly artificial, although useful in a systematic arrangement. The two remaining orders are without bones in the gills, those of the one being soft, and of the other cartilaginous or gristly. These are, the Branchiostegi and Chondropterygii of Artedi, which Linnæus, from a mistake, classed among the Amphibia. The sun fish, the lump fish, the fishing frog, and the seahorse, are of the former, and the sturgeon, the skate, and the shark, of the latter order.

Insects derive their name from being almost always divided, into a head, thorax, and abdomen, with very slender intervening portions: although these divisions do not exist in all insects. They are usually oviparous; they respire, but not by the mouth; they have a number of little orifices on each side of the abdomen by which the air is received into their ramified trachea; and if these are stopped with oil, they are suffocated. Instead of bones, they have a hard integument or shell. Their mouths are formed on constructions extremely various, but generally very complicated: Fabricius has made these parts the basis of his classification; but from their minuteness in most species, the method is, in practice, insuperably inconvenient: and the only way, in which such characters can be rendered really useful, is when they are employed in the subdivision of the genera, as determined from more conspicuous distinctions. Insects have most frequently jaws, and often several pairs, but they are always so placed as to open laterally or horizon-

tally. Sometimes, instead of jaws, they have a trunk, or proboscis. In general they pass through four stages of existence, the egg, the larva or stage of growth, the pupa, or chrysalis, which is usually in a state of torpor or complete inactivity, and the imago, or perfect insect, in its nuptial capacity. After the last change, the insect most frequently takes no food till its death.

The Linnæan orders of insects are the Coleoptera, with hard sheaths to their wings, generally called beetles; the Hemiptera, of which the sheaths are of a softer nature, and cross each other, as grasshoppers, bugs, and plant lice: the Lepidoptera, with dusty scales on their wings, as butterflies and moths; the neuroptera, as the libellula, or dragon-fly, the may-fly and other insects with four transparent wings, but without stings; the Hymenoptera, which have stings, either poisonous or not, as bees, wasps, and ichneumons; the Diptera with two wings, as common flies and gnats, which have halteres, or balancing rods, instead of the second pair of wings; and, lastly, the Aptera, without any wings, which form the seventh order, comprehending crabs, lobsters, shrimps, and prawns, for these are properly insects; spiders, scorpions, millepedes, centipedes, mites and monoculi. The Monoculus is a genus including the little active insects; found in pond-water, which are scarcely visible to the naked eye, as well as the Molucca crab, which is the largest of all insects, being sometimes six feet long. Besides these there are several genera of apterous insects, which are parasitical and infest the human race as well as other animals.

The Vermes are the last and lowest of animated beings, yet some of them are not deficient either in magnitude or in beauty. The most natural division of vermes is into five orders; the Intestina, as earthworms and ascarides, which are distinguished by the want of moveable appendanges, or tentacula, from the Mollusca, such as the dew snail, the cuttle fish, the sea anemone, and the hydra, or fresh water polype. The Testacea have shells of one or more pieces, and most of them inhabit the sea and are called shell fish, as the limpet, the periwinkle, the snail, the muscle, and the oyster, and the barnacle The order Zoophyta contains corallines, sponges, and other compound animals, united by a common habitation, which has the general appearance of a vegetable, although of animal origin; each of the little inhabitants resembling a hydra, or polype, imitating, by its extended arms, the appearance of an imperfect flower. The last order, Infusoria, is scarcely distinguished from the Intestina and Mollusca by any other character than the minuteness of the individuals belonging to it, and their spontaneous appearance in animal and vegetable infusions, where we can discover no traces of the manner in which they are produced. The process by which their numbers are sometimes increased, is no less astonishing than their first production; for several of the genera often appear to divide spontaneously, into two or more parts, which become new and distinct animals, so that in such a case the question respecting the identity of an individual would be very difficult to determine. The volvox, and some of the vorticellæ are remarkable for their continual rotatory motion, probably intended for the purpose of straining their food out of the water: while some other species of the vorticellæ resemble fungi or corallines in miniature.

ZOOPHYTA, in natural history, an order of the class Vermes. Zoophyta are composite animals holding a medium between animals and vegetables. Most of them take root and grow up into stems, multiplying life in their branches and deciduous buds, and in the transformation of their animated blossoms or polypes, which are endowed with spontaneous motion. Plants, therefore, resemble zoophyta, but are destitute of animation and the power of loco motion; and zoophyta are, as it were plants, but furnished with sensation and the organs of spontaneous motion. Of these some are soft and naked, and others are covered with a hard shell: the former are by some naturalists called zoophytes, and the latter are denominated lithophytes. There are fifteen genera, *viz.*

Alcyonium	Madrepora
Antipathes	Millepora
Cellepora	Pennatula
Corallina	Sertularia
Flustra	Spongia
Gorgonia	Tubipora
Hydra	Tubularia
Isis	

The coral reefs that surround many islands, particularly those in the Indian Archipelago and round New Holland, are formed by various tribes of these animals, particularly by the Cellepora, Isis, Madrepora, Millepora, and Tubipora. The animals form these corals with such rapidity,

that enormous masses of them very speedily appear where there were scarcely any marks of such reefs before.

ZOSTERA, in botany, a genus of the Monandria Monogynia class and order. Natural order of Inundatæ. Aroideæ, Jussieu. Essential character : spadix linear, within the sheath of the leaves ; flower bearing on one side ; calyx none; corolla none: anther sessile, opposite to the germ; stigmas two, linear ; capsule one seeded. There is but one species, *viz*, Z. marina, grass wrack, and many varieties.

ZWINGERA, in botany, so named from Theodorus Zwinger, Professor of anatomy and botany at Basil, a genus of the Decandria Monogynia class and order. Natural order of Terebintaceæ, Jussieu. Essential character : calyx five parted ; petals five ; filaments widened at the base, hairy ; capsule five, coriaceous, one-seeded, inserted into a fleshy receptacle, There is but one species, *viz.* Z. amara, a native of the woods of Guiana.

ZYGIA, in natural history, a genus of insects of the order Coleoptera : antennæ moniliform ; feelers equal, filiform ; lip elongated, membranaceous ; jaw one-toothed. There is only one species, *viz.* Z. oblonga, which is found in the East.

ZYGOPHYLLUM, in botany, *bean caper*, a genus of the Decandria Monogynia class and order. Natural order of Gruinales. Rutaceæ, Jussieu. Essential character : calyx five leaved ; petals five ; nectary ten leaved, covering the germ, and bearing the stamens ; capsule five-celled. There are fourteen species, of these the following may be noticed : Z. fætidum, fetid bean-caper : the leaves of this plant stand on long footstalks, and diffuse widely a strong foxy smell : it flowers from July to September. The fruiting peduncle turns back, whence its trivial name retrofractrum. It is a native of the Cape of Good Hope. Z. morgsana, four-leaved bean-caper : has a shrubby stem, divided into many irregular-jointed branches, rising four or six feet high ; leaves thick and succulent, and placed by fours at each joint, two on each side the stalk, opposite ; the fruit has four membranaceous wings, resembling the sails of a mill. Z. arboreum, tree bean-caper, is a very handsome tree, forty feet high, with a very large, thick, elegant head : trunk upright, dividing into numerous opposite branches ; flowers inodorous, large, handsome, which give the tree a most beautiful appearance when in bloom.

CORRECTIONS AND ADDITIONS.

ADHESION, second paragraph: for *about the same time*, read, *about the year* 1713.

ARIANS. For defence of *low Arianism*, read, *defence of Arianism.*

ASTRONOMY. In the fourteenth page of this article, near the top of the first column, read, instead of what is there found, "The diameter at the poles is 7,893 English miles; at the equator it is 7,928 miles."

CAULIS is referred to from ACAULOSE; the reference should have been made to the article BOTANY.

CONCHA. Instead of this, the reference should have been to SHELL.

CORN *laws* is referred to from the article BOUNTY; the reference should have been to the article CORN *trade.*

COUTCHOUC. Read CAOUTCHOUC.

CYCLE is referred to from CALENDAR, but the reference should have been made to CHRONOLOGY, where an account of the several cycles will be found.

EQUATONAL. Read EQUATORIAL.

FISHING *flies* have been referred to from the article ANGLING, and being omitted in the alphabetical order, we add in this place, that a fishing fly is a bait used in angling for various kinds of fish. The fly is either natural or artificial. The chief of the natural flies are the "stone fly," found under hollow stones at the sides of rivers, between April and July; it is brown, with yellow streaks, and has large wings; the "green drake," found among stones by river sides; it has a yellow body ribbed with green, it is long and slender, with wings like a butterfly, and is common in the spring: "the oak fly," found in the body of an oak or ash, is of a brown colour, and common during the summer months: the "palmer fly," or worm, found on the leaves of plants, when it assumes the fly state from that of the caterpillar; it is much used in trout fishing: the "ant fly," found in ant hills from June to September: the "May fly" is to be found playing at the river side, especially before rain: and the "black fly," which is to be found upon every hawthorn after the buds are off. There are two ways to fish with natural flies, either on the surface of the water, or a little underneath it. In angling for roach, dace, &c. the fly should be allowed to glide down the stream to the fish; but in very still water the bait may be drawn by the fish, which will make him eagerly pursue it.

There are many sorts of artificial flies to be had at the shops; they are made in imitation of natural flies, and the rules for using them are as follow. Keep as far from the water's edge as may be, and fish down the stream with the sun at your back; the line must not touch the water. In clear rivers the angler must use small flies with slender wings, but in muddy waters a larger fly may be used. After rain, when the waters are muddy, an orange coloured fly may be used with advantage: in a clear day, the fly must be light coloured, and in dark waters the fly must be dark. The line should in general be twice as long as the rod: but, after all, much will depend on a quick eye and active hand. Flies made for catching salmon must have their wings standing one behind the other. This fish is said to be attracted by the gaudiest colours that can be obtained; the wings and tail should be long and spreading.

FRANKS, or *franking letters,* which ought to have been included in the article POST-OFFICE, is a privilege that has been enjoyed by members of parliament from the first institution of the post-office. The original design of this exemption was, that they might correspond freely with their constituents on the business of the nation. For many years it was sufficient to frank a letter or packet, that any member of parliament subscribed his name at the bottom of the cover. By degrees, however, this privilege was so much abused, that it was enacted that no letter should pass free, unless the whole direction was in the hand writing of the member, and his subscription annexed: a subsequent act obliges the member to write not only the full direction, but to note the town at which the office is where the letter is sent from. A member of parliament can

frank only ten letters on each day, and receive fifteen free of postage: each of which must weigh less than one ounce.

GAURS. This word having been referred to, it is necessary to mention that the Gaurs are an ancient sect of magicians in Persia, where they are employed in the meanest offices, and vilest drudgery. They are said to be harmless in their manners, zealous in their opinions, rigorous in their morals, and exact in their dealings. They profess the worship of one God alone, the belief of a resurrection and a future judgment, and utterly detest all idolatry. They perform their acts of worship in the presence of fire, for which they have much veneration, regarding it as the most perfect emblem of the living and invisible God. They exhibit the same marks of respect for Zoroaster that the Jews have for Moses, esteeming him as a prophet sent from God.

GUIAC. Read GUAIACUM.

HOWITZ, or HOWITZER, in military affairs, a kind of mortar mounted upon a field carriage like a gun. The difference between a mortar and a howitzer is, that the trunnions of the first are at the end, and of the other in the middle. The invention of howitzers is of much later date than that of mortars. The construction is various, but the chamber is always cylindrical. They are distinguished by the diameter of the bore. A battery of howitzers is formed in the same way as a gun-battery, only the embrazures are at least a foot wider, on account of the shortness of the howitzer.

JESUITS. In this article, for *Loyoly* and 1738, read *Loyola* and 1538.

LINARIA has been referred to from LINNET, which is a species of FRINGILLA, and under that article the description will be found.

MUSTELA has been referred to from FERRET, &c. but the reference should have been to VIVERRA, where the principal species are described.

NAZARENES, in church history, has been referred to from the article EBIONITES; and being omitted in its proper place, we may observe here, that it was a name originally applied to Christians in general, as followers of Jesus of Nazereth; but was afterwards restrained to that sect, who endeavoured to blend the institutions of the mosaic law with those which are peculiar to the gospel.

NECROMANCY being referred to, we define the term as a species of pretended divination, performed by raising the dead, and extorting answers from them.

PERSICA was referred to from NECTARINE, but the reference should have been to AMYGDALUS, of which genus the persica, or nectarine, is only a species.

PRINTING; *stereotype*. In the second paragraph, for *by* the Jesuits, read *say* the Jesuits. See STEREOTYPE.

STAMP *duties*, a branch of the public revenue, raised by requiring that all deeds or documents, in order to be valid, shall be written on paper or parchment bearing a public seal, for which a tax is paid. This mode of taxation was introduced into England in 1671, by "an act for laying an imposition on proceedings at law;" but the act in 1694, for imposing several duties upon vellum, parchment and paper, may be considered as the commencement of the present Stamp Office, as a particular set of commissioners was then appointed for managing the duties. These duties at first were to continue only for a limited period, but about the year 1698 several new ones were granted, to continue for ever, to which, additions, almost without end, have, at different times, been since made, as will appear from the following statement. The total gross produce of the stamp duties, in the year 1713, was 107,779*l.*, the charges of management of which amounted to 14,296*l.*, leaving a nett produce of only 93,483*l.* In 1723 the nett produce had increased to 130,409*l.*; and it seldom exceeded this amount till 1757, when some new stamp duties were imposed, by which the total nett amount of this revenue was increased to 267,725*l.*: In 1766 it amounted to 285,266*l.*; and no material additions were made till towards the conclusion of the American war. In 1782, a duty was imposed on fire-insurances, which, though not actually collected by means of stamps, was classed with the stamp duties. In 1784, additional duties were laid on gold and silver plate. In 1785, duties were laid on post-horses, quack medicines, game licenses, attorneys' licenses, and pawnbrokers; all of which were deemed stamp duties, and considerably augmented the annual amount. But a far greater increase took place in the course of the war which began in 1793, during which new stamp duties were imposed on receipts, bills of exchange, attorneys' articles, sea-insurances, licenses to wear hair-powder, horse dealers' licenses, legacies, hats, stage-coaches, deeds, armorial bearings, small notes, medicines, and several other articles, which soon increased this branch of the revenue to more than double its former amount; and it is a mode of tax-

ation, which it is in general so difficult to evade, and is attended with such a comparatively small expense in collecting, that there can be little doubt that it will be extended as far as possible.

The total produce of stamp duties of Great Britain the year ending in January, 1806, was 4,194,285*l.* 12*s.* 10½*d.* This sum was subject to some deductions, but when these were made, the produce was little less than four millions sterling. The expense of collection amounts to 3¼ per cent. on the gross revenue. The following are some of the principal stamp duties in which the public are most interested, payable after the 10th of October, 1808.

RECEIPTS, BILLS OF EXCHANGE, &C.

	l.	*s.*	*d.*
Receipt for the payment of money amounting to 2*l.* and under 10*l.*	0	0	2
To 10*l.* and under 20*l.*	0	0	4
To 20*l.* and under 50*l.*	0	0	8
To 50*l.* and under 100*l.*	0	1	0
To 100*l.* and under 200*l.*	0	2	0
To 200*l.* and under 500*l.*	0	3	0
To 500*l.* or upwards	0	5	0
In full of all demands	0	5	0

N. B. Any general acknowledgment of the settlement of any account or debt, where the amount is not specified, is liable to the duty of 5*s.*

Inland Bill of Exchange, draft, or order for payment to bearer, or order, on demand, or otherwise:

	l.	*s.*	*d.*
Amounting to 40*s.* and not exceeding 5*l.* 5*s.*	0	1	0
Above 5*l.* 5*s.* to 30*l.*	0	1	6
Above 30*l.* to 50*l.*	0	2	0
Above 50*l.* to 100*l.*	0	3	0
Above 100*l.* to 200*l.*	0	4	0
Above 200*l.* to 500*l.*	0	5	0
Above 500*l.* to 1,000*l.*	0	7	6
Above 1,000*l.* to 3,000*l.*	0	10	0
Above 3,000*l.*	1	0	0

N. B. Every species of order or receipt, which, being given as a consideration for money, enables the payee to receive the sum expressed therein from a third person, is considered as a bill of exchange; excepting drafts to *bearer on demand,* drawn on any banker residing within 10 miles of the place where the same is drawn, provided the place be specified thereon. Bank bills and bank post bills, and bills drawn for wages, &c. of navy and army, are exempted from the duty.

Foreign Bill of Exchange, if drawn singly, the same duty as the inland bill. Drawn in sets: for every bill of each set not

	l.	*s.*	*d.*
Exceeding 100*l.*	0	1	0
Above 100*l.* to 200*l.*	0	2	0
Above 200*l.* to 500*l.*	0	3	0
Above 500*l.* to 1,000*l.*	0	4	0
Above 1,000*l* to 3,000*l.*	0	5	0
Above 3,000*l.*	0	10	0

Promissory Note to bearer on demand, (intended to be re-issued:)

	l.	*s.*	*d.*
Not exceeding 1*l.* 1*s.*	0	0	4
Above 1*l.* 1*s.* to 2*l.* 2*s.*	0	0	8
Above 2*l.* 2*s.* to 5*l.* 5*s.*	0	1	0
Above 5*l.* 5*s.* to 20*l.*	0	1	6
Above 20*l.* to 30*l.*	0	3	0
Above 30*l.* to 50*l.*	0	4	6
Above 50*l.* to 100*l*	0	7	6

Promissory Note in any other manner than to bearer on demand, (not re-issuable:)

	l.	*s.*	*d.*
Amounting from 40*s* to 5*l.* 5*s.*	0	1	0
Above 5*l.* 5*s.* to 30*l.*	0	1	6
Above 30*l.* to 50*l.*	0	2	0
Above 50*l.* to 100*l.*	0	3	0

Promissory Note, either to bearer on demand, or in any other manner, (not re-issuable:)

	l.	*s.*	*d.*
Above 100*l.* to 200*l.*	0	4	0
Above 200*l.* to 500*l.*	0	5	0
Above 500*l.* to 1,000*l.*	0	7	6
Above 1,000*l.* to 3,000*l.*	0	10	0
Above 3,000*l.*	1	0	0

PROBATES OF WILLS, OR LETTERS OF ADMINISTRATION.

		l.	*s.*
Above the value of 20*l.* and under 100*l.*		0	10
Of 100*l.* and under 200*l.*		2	0
200*l.*	300	5	0
300	450	8	0
450	600	11	0
600	800	15	0
800	1,000	22	0
1,000	1,500	30	0
1,500	2,000	40	0
2,000	3,500	50	0
3,500	5,000	60	0
5,000	7,500	75	0
7,500	10,000	90	0
10,000	12,500	110	0
12,500	15,000	135	0

15,000*l.* and under	17,500	160	0
17,500	20,000	185	0
20,000	25,000	210	0
25,000	30,000	260	0
30,000	35,000	310	0
35,000	40,000	360	0
40,000	45,000	410	0
45,000	50,000	460	0
50,000	60,000	550	0
60,000	70,000	650	0
70,000	80,000	750	0
80,000	90,000	850	0
90,000	100,000	950	0
100,000	125,000	1,200	0
125,000	150,000	1,400	0
150,000	175,000	1,600	0
175,000	200,000	2,000	0
200,000	250,000	2,500	0
250,000	300,000	3,000	0
300,000	350,000	3,500	0
350,000	400,000	4,000	0
400,000	500,000	5,000	0
500,000 or upwards		6,000	0

Probates, &c. of seamen, marines, or soldiers, exempted.

LEGACIES.

All legacies, pecuniary or specific, out of personal estate, or charged on real estate; and all residues of personal estate, whether devised by will, or accruing by succession, and all shares and residues arising from the sale of real estate under a will. If the value amounts to or exceeds 20*l.* a duty per cent. as follows:

To children of the deceased, or their descendants, 1*l.*

To a brother or sister of the deceased, or their descendants, 2*l.* 10*s.*

To a brother or sister of the deceased's father or mother, or their descendants, 4*l.*

To a brother or sister of the deceased's grandfather or grandmother, or their descendants, 5*l.*

To any collateral relation, or to a stranger in blood, 10*l.*

The husband or wife of the deceased is exempt from the above duties.

ANNUAL LICENCES.

Licence to appraiser (not a licensed auctioneer) annual, 6*s.*

To any banker, &c. who shall issue any promissory note payable on demand, and be re-issuable, 20*l.*

For selling medicines, &c. liable to duty under said act, 44 George III. c. 98, (usually called quack medicines:)

In London or Westminster, (or within the two-penny post,) and in Edinburgh, 2*l.*

In any other city, borough, or town corporate, or in Manchester, Birmingham, or Sheffield, 10*s.* In any other place, 5*s.*

For exercising the trade of a pawnbroker:

In London or Westminster, or two-penny post district, 10*l.* In any other place, 5*l.*

By postmasters, or persons letting to hire horses, for travelling post, by the mile, or from stage to stage, or for a day, or for any less period than 28 days, for drawing carriages used in travelling post, 5*s.*

By persons keeping public stage coaches or carriages, for each carriage so kept:

If carrying 4 inside passengers,	5*s.*
More than 4 and not more than 6,	6*s.*
More than 6 and not more than 8,	7*s.*
More than 8 and not more than 10,	8*s.*
More than 10,	9*s.*

Children in lap are excepted from the several numbers.

PROCEEDINGS IN THE COURTS.

Duties on *Law Proceedings*, in the courts, to be paid in respect of every skin, sheet, &c. except where they are imposed according to the number of words, or otherwise expressly charged.

MISCELLANEOUS.

As fellow of the College of Physicians, in England or Scotland, 20*l.*

By licence from the College of Physicians to practise within seven miles of the metropolis, 10*l.*

Matriculation in any university in Great Britain, 10*s.*

To the degree of bachelor of arts in ordinary course, 3*l*,

By special grace, royal mandate, or nobility, or otherwise out of ordinary course, 5*l.*

Any other degree in the ordinary course of the university, 6*l.* Out of the ordinary course, 10*l.*

To the degree of M. D. in either of the universities of Scotland, 10*l.*

Advertisements in the London Gazette, or any public newspaper, 3s.

Agreement, or Memm. of Agreement, made in England under hand only, or in Scotland without any clause of registration, and not otherwise charged nor expressly exempted in the schedule; the matter thereof being of the value of 20*l.* or upwards, and containing not more than

CORRECTIONS AND ADDITIONS.

1,080 words, including any schedule, &c. 16s. Containing more than 1,080 words, 1l. 10s. And further, for every 1,080 words beyond the first 1,080, 1l.

Almanack or *Calendar* for the year, or less, 1s. If for more years, then for each year for which it shall serve, 1s. Perpetual Almanack, 10s.

Calendars or perpetual almanacks, in bibles or prayer books, excepted.

Appraisement of estate, real or personal, in any case whatsoever, except appraisement by order of an admiralty court, amount not exceeding 50l., 2s. 6d.—Exceeding 50l. to 100l., 5s.—Exceeding 100l. to 200l., 10s.—Exceeding 200l. to 500l., 15s—Exceeding 500l., 1l.

Articles of Apprenticeship and Clerkship. Any profession or trade, &c. except attorneys and others specifically charged, where the premium does not amount to

			l.	s.	d.
30l.			0	15	0
30l. and under	50l.		1	10	0
50l.	100l.		2	10	0
100l.	200l.		5	0	0
200l.	300l.		10	0	0
300l.	400l.		15	0	0
400l.	500l.		20	0	0
500l.	600l.		25	0	0
600l.	800l.		30	0	0
800l.	1,000l.		40	0	0
1,000l. or upwards			50	0	0

Bond in England, and personal bond in Scotland, as security for a definite sum:

			l.	s.
Not exceeding 100l.			1	0
Exceeding	100l. to	300l.	1	10
	300l.	500l.	2	0
	500l.	1,000l.	3	0
	1,000l.	2,000l.	4	0
	2,000l.	3,000l.	5	0
	3,000l.	4,000l.	6	0
	4,000l.	5,000l.	7	0
	5,000l.	10,000l.	9	0
	10,000l.	15,000l.	12	0
	15,000l.	20,000l.	15	0
	20,000l.		20	0

Where the total amount of the money secured, or to be ultimately recoverable, shall be uncertain, being for money to be hereafter advanced, or to become due on account current, 20l.

Certificate to be taken out yearly, by attornies, solicitors, or proctors, in England; and by writers to the signet, solicitors, agents, attornies, or procurators, in any of the courts in Scotland; notaries public in England and Scotland; and also by every sworn clerk, clerk in court, and other officer, who shall act in any of the above capacities for any other emolument than the regular emolument of the office: when residing within the limits of the two-penny post in England, or within the city or shire of Edinburgh, and if he shall have been admitted 3 years or upwards, 10l. Or if not so long admitted, 5l. When residing elsewhere, and admitted for three years, or upwards, 6l. Or if not so long admitted, 3l.

Conveyance (whether grant, assignment, transfer, renunciation, or of any other description whatever) on the sale of any lands, rents, or other property, real or personal, heritable or moveable, or of any right, title, interest, &c. in the same; for the principal or only deed whereby such property shall be granted or conveyed to or vested in the purchaser, &c.

Where the purchase-money (which shall be truly expressed therein) shall not amount to 50l., 15s.

			l.	s.
To	50l. and not to	150l.	1	0
	150l.	300l.	1	10
	300l.	500l.	2	10
	500l.	750l.	5	0
	750l.	1,000l.	7	10
	1,000l.	2,000l.	10	0
	2,000l.	3,000l.	20	0
	3,000l.	4,000l.	30	0
	4,000l.	5,000l.	40	0
	5,000l.	7,500l.	50	0
	7,500l.	10,000l.	75	0
	10,000l.	15,000l.	100	0
	15,000l.	20,000l.	150	0
	20,000l.	30,000l.	200	0
	30,000l.	40,000l.	300	0
	40,000l.	50,000l.	400	0
	50,000l. or upwards		500	0

Grant of the dignity of a Duke, 200l.; Marquis, 200l.; Earl, 200l.; Viscount, 150l.; Baron, 100l.; and Baronet, 50l. Of a congé d'elire, 20l. Of the royal assent to the election of Archbishop or Bishop, 20l.

Grant under the great or privy seal from the civil list, &c. (not part of annual supplies or voted by Parliament):

		l.	s.
Under 100l.		1	10
100l. and not	250l.	4	0
250l.	500l.	10	0
500l.	750l.	20	0
750l.	1,000l.	30	0
1,000l. or upwards, for every 100l. thereof		5	0
Of any annuity or pension,			
Under 100l. per annum		1	10
100l. and not	200l.	4	0

				l.	s.
Under	200l.	. . .	400l.	10	0
. . . .	400l.	. . .	600l.	20	0
. . . .	600l.	. . .	800l.	30	0
. . . .	800l.	. . .	1,000l.	40	0
. . .	1,000l. or upwards		. .	50	0

But in cases of renewal only, 1*l.* 10*s.*

Grant, of any office or employment, by letters patent, deed, or other writing, the salary, fees, &c. not amounting to

			l.	s.
50l. per annum		. . . .	1	10
50l. and not	100l.	. .	3	0
100l. . . .	200l.	. .	5	0
200l. . . .	300l.	. .	10	0
300l. . . .	500l.	. .	20	0
500l. . . .	750l.	. .	30	0
750l. . . .	1,000l.	. .	40	0
1,000l. . . .	1,500l.	. .	50	0
1,500l. . . .	2,000l.	. .	75	0
2,000l. . . .	3,000l.	. .	100	0
3,000l. per ann. or upwards		.	150	0

Mortgage, conditional surrender by way of mortgage, &c. wadset, conveyance in trust, defeasance, or other deed, intended as a security by way of mortgage, where the same shall be made, as a security for the payment of any definite sum of money, advanced or lent at the time, or previously due and owing, or forborne to be paid, being payable.

				l.	s.
Not exceeding 50l.			. . . .	0	15
Exceeding	50l.	to	100l.	1	0
. . . .	100l.	.	150l.	1	10
. . . .	150l.	.	300l.	2	0
. . . .	300l.	.	500l.	3	0
. . . .	500l.	.	1,000l.	4	0
. . . .	1,000l.	.	2,000l.	5	0
. . . .	2,000l.	.	3,000l.	6	0
. . . .	3,000l.	.	4,000l.	7	0
. . . .	4,000l.	.	5,000l.	8	0
. . . .	5,000l.	.	10,000l.	10	0
. . . .	10,000l.	.	15,000l.	12	0
. . . .	15,000l.	.	20,000l.	15	0
. . . .	20,000l.	.	. . .	20	0

This *ad valorem* duty is chargeable only on *one part* of the mortgage deed, the other being liable as a common deed. It is not chargeable on mortgages made merely for further assurance, in cases where the *ad valorem* duty has been paid on other deeds.

Newspapers, (For every half sheet double demy, or sheet of single demy) 3½*d.*

Pamphlets, of half a sheet or less, ½*d.* not exceeding a sheet, 1*d.*

Pamphlets exceeding 1 sheet, and not exceeding 6 sheets, in octavo, (or on a lesser page) 12 sheets quarto, or 20 sheets folio. For every sheet contained in one copy, 2*s.*

Acts of parliament, proclamations, orders of council, form of prayer, and acts of state, ordered to be printed by the King; printed votes of parliament, school books, and books of devotion, are exempted.

Passport, 5*s.*

Plate of Gold, wrought in Great Britain, per oz. and in proportion, 16*s.* Gold watch cases excepted.

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STRAW *hat manufacture*, is of very modern invention; it has, however, of late years afforded the means of support to a large class of our industrious poor, and of not a few in the middle ranks of life. The manufacture requires but little capital, and the art is quickly acquired. Thirty or forty shillings are said to be sufficient for the purchase of the machines and materials for employing one hundred persons some length of time. The straw used is readily obtained, and, when properly sorted, it is cut at the joints, and the outer covering being removed, it is then ranged according to the different sizes, and made up into bundles of eight or ten inches in length, and about a foot in circumference. The bundles are then dipped in water, and shaken a little, so as not to retain much moisture; and then they are to be placed on their edges

in a box, which is sufficiently close to prevent the evaporation of the smoke. In the middle of the box is an earthen vessel, containing sulphur, which is set on fire, and the box covered over for several hours. The straws are next to be split, which operation is performed by a small machine, made chiefly of wood. When split, the straws are denominated splints, and of these each braider has a certain quantity, which they hold under the arm, and draw them out as wanted. The rules laid down are these: platters should be taught to use their second fingers and thumbs, instead of the fore fingers, which are often required to assist in turning the splints, and very much facilitate the platting; and they should take care not to wet the splints too much. Each platter should have a small linen bag, and a piece of pasteboard to roll the plat round. When five yards are worked up, it is wound about a piece of board, fastened at the top with yarn, and kept there several days, to form it in a proper shape. Four of these parcels, or a score, is the measurement by which the plat is sold. When the straw is platted, it comes into the hand of the person who sews it together into the form of hats, bonnets, &c. of various shapes and sizes. These are then put on wooden blocks, for the purpose of hot pressing; and, to render them of a more delicate white, they are again exposed to the fumes of sulphur.

STURGEON, a species of the Acipenser genus is referred to, and being omitted in its place, we may briefly observe, that it is a very large fish, of eighteen or twenty feet long, an inhabitant of the northern seas, migrating during the early summer months into the larger rivers and lakes, and returning to the sea again in autumn after having deposited its spawn. It is a fish of slow motion and is easily taken: it is admired for the delicacy and firmness of the flesh. From the roe is prepared the substance called caviar. In this country the sturgeon annually ascends rivers, but in no great quantities, and is occasionally taken in salmon nets. In its manner of breeding the sturgeon forms an exception among cartilaginous fishes, it being oviparous. The sturgeon was a fish in high repute among the ancients, and was brought to table with much pomp, and ornamented with flowers, the slaves who carried it being likewise adorned with garlands, and accompanied with music. The flavour of the sturgeon is said to vary with the food on which it is chiefly fed; hence it is distinguished in the North of Europe, into mackrel-sturgeon, herring-sturgeon, &c. See Shaw's "Zoology."

SUBSTANCES, *simple.* To this article references have been made, and it having been omitted in the alphabetical order, we must not pass it by here. In other cases we are grieved that haste or negligence should have required these additions and corrections; in this we have reason for different emotions, having by the omission an opportunity of stating some facts, and some results, which have not been made public more than two or three days.

In the language of modern chemistry, the term simple substances has a different signification from that attached to it in ancient philosophy. By elements, or simple substances, was formerly understood primary principles, which were essentially simple and indestructible, which, by modification of form, or by mutual combination, formed the different substances which compose the material world. Modern philosophy pursues a different mode of investigation: it analyses substances, and endeavours to decompose them, or separate them into their constituent parts, and when it arrives at any which it cannot decompose, and beyond which analysis cannot be carried, and whose properties can only be changed by causing them to combine with others, then such substances are denominated simple. This term does not imply their absolute simplicity, because new experiments, or new agents, may be able to reduce certain bodies that at present have not been decomposed into others that are more simple. Till very lately the fixed alkalies, the boracic, fluoric, and muriatic, acids were reckoned among the simple substances: to these may be added the metals, the several earths, sulphur, phosphorus, and the diamond.

By the Voltaic battery, in the hands of Mr. Davy, Professor of Chemistry at the Royal Institution, many of these substances, which were deemed simple a few months since, have been decomposed. For his experiments on the alkalies, we refer to the articles ALKALI and POTASSIUM: and on Saturday last, Dec. 17th, he announced in his public lecture, that he had decomposed sulphur and phosphorus, the component parts of which are oxygen and hydrogen, and a metallic base; that charcoal he had found to consist of hydrogen and the carbonaceous principle, and that diamond was a compound of the carbonaceous principle and

oxygen; that he had succeeded in obtaining the metallic base of ammonia, which, when combined with mercury, in the proportion of only $\frac{1}{12000}$th part, rendered the mercury solid, and reduced the specific gravity from 13 to 3. The professor likewise informed his audience, that he had decomposed the boracic and fluoric acids, and had enjoyed a glimpse of their metallic bases; and that he had fully ascertained, that lime, magnesia, strontites, and barytes, are compound bodies, each having a metallic substance as a base. Hence the number of simple substances, which, but a year ago, was estimated by Dr. Thomson at 38, is in a very short space of time considerably reduced. Chemistry, indeed, as a science, will probably uudergo a complete renovation: the discoveries of Mr. Davy promise a total overthrow to the beautiful, and as it was formerly deemed, simple and almost perfect system of Lavoissier. The English professor assumes electricity as a general agent of decomposition; that different bodies are naturally in different electrical states; that by altering these states their affinities are altered. In justification of this theory, he has ascertained that oxygen, and all bodies containing an excess of oxygen, are naturally negative, and that all bodies containing an excess of inflammable principle are naturally positive. Should subsequent facts confirm this theory, it is highly probable that many other of the bodies, hitherto regarded as simple, will yield to the powers of his apparatus.

SUBSTANCES, *imponderable*, in chemistry, are caloric, light, electricity, and galvanism; perhaps the identity of the two former may hereafter be discovered: and likewise that of the two latter more completely demonstrated. The common character that they all possess is, that of not being subject to the attraction of gravitation; at least their gravity has hitherto been incapable of appreciation, hence the term "imponderable." They possess the greatest subtilty, or tenuity; they cannot easily be obtained in a separate state of existence; they are observed only in states of combination, or in their rapid transition from one body to another. We can scarcely discover their specific affinities, or measure their force, and we are unable to trace their particular combinations, or consider them as essential constituent principles of any compound. They are moreover diffused over every kind of matter; at least caloric exists in all bodies, and probably also the electric and galvanic agents. See Murray's Chemistry.

TELESIE, in mineralogy, a gem so named by Haüy, which answers to the perfect CORUNDUM and the SAPPHIRE: to these articles the reader might be referred without further addition, but having directed him already to TELESIE from the article GEM, we shall, in this place, give Mr. Murray's description. It occurs in fragments, and is crystallized; the form of its crystals being the double three-sided pyramid, the single six-sided pyramid, and the six-sided prism, variously modified by truncations and acuminations. Its colours are numerous; blue, green, red, of numerous shades, and yellow or yellowish white, and sometimes more than one colour is present even in the same crystal. It is more or less transparent; its lustre is resplendent and vitreous; and it often presents a beautiful reflection of light, in the form of a star: the fracture is conchoidal, or imperfectly foliated; the hardness is inferior to that of the diamond, but superior to that of every other fossil, and not yielding to the file: the specific gravity is from 3.9 to 4.1.

TIME, *equation of*, the most usual and best measure of time that we have is a clock, regulated by the vibration of a pendulnm. But with whatever accuracy a clock may be made, it must be subject to irregularities, as well from the imperfection of the workmanship, as from the expansion and contraction of the materials by heat and cold, by which the length of the pendulum, and consequently the time of vibration, will vary. As no clock, therefore, can be depended upon for keeping time accurately, it is necessary that we should be able at any time to ascertain how much it is too fast or too slow, and at what rate it gains or loses. For this purpose it must be compared with some motion which is uniform, or of which, if it be not uniform, one can find the variation. The motions of the heavenly bodies have therefore been considered as most proper for the purpose. Now as the earth revolves uniformly about its axis, the apparent diurnal motion of the heavenly bodies about the axis must be uniform. If a clock, therefore, be adjusted to go 24 hours from the passage of any fixed star over the meridian till it returns to it again, its rate of going may be determined by comparing it with the transit of any fixed star, and observing whether the interval continues to be 24 hours; if not, the difference shows how much it gains or loses in that time. A

clock thus adjusted is said to be adjusted to sidereal time, and all the sidereal days are equal. But all the solar days are not equal, that is, the intervals from the sun's leaving the meridian till it returns to it again, are not all equal; so that if a clock be adjusted to go 24 hours in one interval, another interval will be performed in more or less than 24 hours, and thus the sun and the clock will not agree; that is, the clock will not continue to show 12 when the sun comes to the meridian. It is found that the length of the solar day is equal to the time of the earth's rotation about its axis, together with the time of describing an angle equal to the increase of the sun's right ascension in a true solar day. Now if the sun moved, or appeared to move, uniformly, and in the equator, this increase would be always the same in the same time, and therefore the solar days would be all equal; but the sun moves, or appears to move, in the ecliptic; and, therefore, if its motions were uniform, equal arcs upon the ecliptic would not give equal arcs upon the equator. But the apparent motion of the sun in the ecliptic is not uniform, and hence also any arc upon the ecliptic, described in a given time, is subject to a variation, and consequently that on the equator is subject to a variation. The increase then of the sun's right ascension in a true solar day, varies from two causes: first, because the ecliptic, in which the sun appears to move, is inclined to the equator; secondly, because his motion in the ecliptic is not uniform, therefore the length of a true solar day is subject to a continual variation; consequently, a clock which is adjusted to go 24 hours for any one true solar day, will not continue to show 12 when the sun comes to the meridian, because the intervals by the clock will continue equal, if the clock be supposed accurate, but the intervals of the sun's apparent passage over the meridian are not equal.

As the sun appears to move through 360° of right ascension in about $365\frac{1}{4}$ days, therefore $365.25 : 1$ day $:: 360° : 59' \; 8'' \; 2'''$, the increase of right ascension in one day, if the increase were uniform; or it would be the increase in a mean solar day, that is, if the solar days were all equal; for they would be all equal, if the sun's right ascension increased uniformly. As the earth describes an angle of 360° 59′, about its axis in a mean solar day of 24 hours, and an angle of 360° in a sidereal day, we say, as $360° \; 59' \; 8'' \; 2''' : 360° :: 24^h : 23^h \; 56' \; 4''$, the length of a sidereal day in mean solar time; or the time from the passage of a fixed star over the meridian till it returns to it again. From these considerations it will be evident, that if a clock be adjusted to go 24 hours in a mean solar day, it will not continue to coincide with the sun, that is, to show 12 when the sun comes to the meridian, because the true solar days differ in length from a mean solar day; but the sun will pass the meridian, sometimes before 12, and sometimes after 12, and this difference is called the equation. A clock thus adjusted, is said to be adjusted to mean solar time. The time shown by the clock is called true or mean time; and that shown by the sun is called apparent time: thus, when the sun comes to the meridian, it is said to be 12 o'clock apparent time. Hence the time shown by the sun-dial is apparent time, and therefore a dial will differ from a clock by how much the equation of time is on that day. When, therefore, we set a clock or watch by the dial, we must attend to what the equation of time is upon that day by a table, such as that given below, and allow for it: thus, if the equation be 4 minutes, as it is on new year's day, and the watch or clock be faster than the sun; then the watch or clock must be made to show 4 minutes past 12 when the dial shows 12 precisely. On the 30th of April, when the dial shows 12, the clock or watch, to be accurate, must want 3 minutes of that hour, and so of the rest. In calculating tables of the equation of time, for every day in the year, the sun and clock are set together, when the sun is in his apogee, and then they investigate the difference between the sun and the clock, for every day at noon, and insert them in a table, stating, by means of the signs + and —, how much the clock is before or after the sun. The inclination of the equator to the ecliptic, upon which the equation of time partly depends, and the place of the sun's apogee, when the clock and sun set off together, being both subject to vary, the equation of time for the same days of the year will every year vary, and therefore it must, where great accuracy is required, be calculated for every year. Besides the time when the sun is in his apogee, there are three other times of the year when the clock and sun agree, or when mean and apparent time is the same, as will be seen in the following table, which is adapted to the second year after Bissextile, and will always be found within a few seconds of the truth, and, therefore, sufficiently accurate for all common purposes.

CORRECTIONS AND ADDITIONS.

TABLE FOR THE EQUATION OF TIME.

Jan. 1	4 +	April 1	4 +	Aug. 9	5 +	Oct. 2	16 —
3	5	4	3	15	4	Nov. 15	15
5	6	7	2	20	3	20	14
7	7	11	1	24	2	24	13
9	8	15	0	28	1	27	12
12	9	*		31	0	30	11
15	10	19	1 —	*		Dec. 2	10
18	11	24	2	Sep. 3	1 —	5	9
21	12	30	3	6	2	7	8
25	13	May 13	4	9	3	9	7
31	14	29	3	12	4	11	6
Feb. 10	15	June 5	2	15	5	13	5
21	14	10	1	18	6	16	4
27	13	15	0	21	7	18	3
Mar. 4	12	*		24	8	20	2
8	11	20	1 +	27	9	22	1
12	10	25	2	30	10	24	0
15	9	29	3	Oct. 3	11	*	
19	8	July 5	4	6	12	26	1 +
22	7	11	5	10	13	28	2
25	6	28	6	14	14	30	3
28	5			19	15		

TRIGONOMETRY. Some of the references to the figures are not quite correct, but the figures speaking so plainly for themselves, a more particular correction is deemed unnecessary.

UNITARIANS. In the third page of this article, for *Polones Fratres*, read *Fratres Poloni*. In the fifth page, for *similar*, read *nearly similar*.

Such, it is believed, are the chief errors and omissions: others of less importance, the candid and liberal reader will excuse, and will readily correct for himself.

THE END.

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William Dunn
Peter M. Ledbetter
Joseph E. Davis
Benj. H. Coupland
Abner W. Kilpatrick
William Ross
Herbert Gregory
W. L. Everitt
Timo. Thorpe
Addison Powel
L. H. Vaughan
Charles Ridout
Elgin Russell
James A. Eckles
Robert Bolling
Hartwell Rawlinge

Essex County,

John Belfield
John Downey
Tunstall Banks
Wm. V. Montague
John Hail
Laurence Muse
John Jones
Benj. Blake
James W. Stephens
Wm. R. Jeffries
Richard Coghill
Townley Banks
Wm. B. Matthew
Winter Bray
John S. Bevan
Thos. Pilcher
Richard Craxton
James L. Cox

John H. Micou
Thomas C. Braxton
William T. Brooke
Thomas Street
William Owen
Edmund F. Noel
Thomas Jesse
Isaac Fisher
Charles Hill

Fairfax County.

Thomas Timmes
Daniel Platt
Stuart G. Thornton
George Milford
Thomas Simms
James H. Hox
William P. Richardson
John Ratcliff
Francis M. Beckwith
Samuel Ratcliff
William Moss
George W. Hunter
William B. Melvyn
Edmund Payne
Daniel M'Chichester
William C. Broadwater
George H. Ferrett
John Dulive
John C. Hunter
Spencer Jackson
Lewis Barrick
Elijah Ogden
William White
John Fitzhugh
Spencer Ball
P. B. Redd
G. W. Lane
William Hancock
John Henning
Stephen Daniel
George Britton
Jennings Beckwith
James Reid

Farquier County.

David Rodes
William Thompson
William Smith
Alexander S. Craig
Thomas O. Gunnings
Robert Brent
Bailey Bruce
James W. White
Francis W. Brooke
James W. Wallace
William B. Cordell
Thomas L. Fitzhugh
Martin E. Carter
Richard Thompson
John Edmonds, junr.
Charles Bell
M'Carty Roy
Richard Chichester, junr.
Joseph Weaver
John E. Blackwell
A. Pollard
John S. Rust
Edward Carter
William M'Coy
Elias E. Edmonds
Andrew Turner
Marcus Russell
Thomas Ashby
Josiah Murray
Edmund Sharpe
Hancock, Lee, & Co.
Turner Ashby
William M. Wallace
John Ashby

Frederick County.

Edmund Pendleton
E. Carson
James Pine
John P. Sanford
Peter E. Sperry
William M'Fee
James Barr, junr.
Alfred D. Ashley
William Eskridge
Charles Brent, junr
George Brent
J. A. Xaupi
Willford Settle
George Knight
John Severs
Robert Beaty
Thomas Thatcher
William P. Thomas
Samuel Simpson
William M. Robertson
John Newmer
Jab. Sutt
Thomas Amiss
William H. Triplett
Calvin Gold
Cyrus D. Baldwin
Richard B. Beckwith
Jacob Cooper
A. P. Buchanan

Franklin County.

John H. Guerant
Edmund Tate
Thomas B. Greer
George W. Clements
William B. Boyd
William Calloway
Miles B. Elam
J. Early
John Calloway
R. F. Woods
William Langhorn
Fleming Saunders
Samuel Harrstan
Josiah Dickenson
James H. Townes
Robert H. Calhoun
Samuel H. Woods

Goochland County.

Samuel Woodson
Isaac Pleasants
N. M. Vaugn
G. Woodson Payne
Alexander A. Campbell
Robert Pleasants
Edward Mosby
Charles Atkinson
Richard Redford
James W. Bates
William S. Fowler
John Martin
Jacob B. Fowler
George S. Smith
David Mims
Josiah Hatcher
N. M. Miller
Henry G. Pill
David Royster
Tarlton Woodson
William F. Carter
Mayer Pollack
John G. Miller
Robert Ware
John Shelton, sen.
J. P. Cosby

Greensville County.

William S. Jeffries
L. R. Robinson
John E. Williamson
Littleton Bailey
William H. Coman
Meredith H. Hobbs
William Fox
William Parham
John H. Hobbs
Robert Wilkinson
Jesse A Bonner
Hardy Robinson
G. H. Bathe
Timothy Thorp
S. Chambliss
James C. Fennell
William Dancy
George Goodrun
Hinchia C. Petway
Matthias Debbery

Augustine Claiborne
Etheldred H. Lundy
D. I. Claiborne
E. Mason
Thomas Batts
James A. Watson
William J. Calvin
David R. Rmith
William Mason
Francis Hill

Gloucester County.

John Bracken, junr.
Peyton R. Nelson,
Peter Kemp
Catesby Jones
Francis Whiting
Thomas Whiting
John Lewis
Edward B. S. Carey
Willis Perrin
John M. Gayle
Sharp Whiting
John Ransome
William Taliaferro
P. W. Lewis
Robert Thurston
Thomas C. Amory
Overton Seawell
John D. Grisett
William A. Rogers
George B. Field
Robert Wilkins
James Ransome
Mann Page
Richard Taliaferro
J. B. Fox

Halifax County.

Charles W. Cheatham
William T.Craddock, M.D.
John K. Lynn
Charles Scott
John Kerr
John S. Glascock
John Conner
Thomas L. Spraggins
Elisha Barksdale
Littlejohn M'Cargo
Thomas Canner
William T. Ferry
Duke W. Rowlet
John Sims
Thomas M'Cargo
Reuben Palmer
William H. Wallington
Joseph Jones
B. Williams
William Miller

Hanover County.

Joseph Holt
William S. Pryor
Joseph Wingfield
Hector Davis
Leonard Timberlake
William Priddy
Edmund Higgason
Stephen Sutton
Edmund C. Goodwin
W. R. Nelson
Samuel Richardson
Henry Curtiss
W. D. Taylor
John B. Nelson
William Morris
Charles P. Goodall
J. W. Ellis
Wiliam O. Harris
Robert B. Honeyman

Henrico County.

Samuel Price
Nathaniel W. Price
Jsaac White
R. L. Bohannan
Philip Budlong
John A. Lancaster
Turner Christian
John Wilson
Simon Frayser
A. Hodges
R. M. Sizer
William Cowan
Richard A. Carrington
Hubert A. Claiborne
John Goode
Richard Carter
James M'Intosh
Thomas Cooke
John A. Simms
Philip C. Sturtivant
John Strother
William Smith
John Leuovi
Williamson Wynne
George Booker
Daniel Trueheart
Mann Satterwhite
William S. Tucker
Joseph S. James
George Perkins
Jacob Lyon
Richard Woodfolk
Robert Picket
Robert Greenhow
John Patten
William Wilson
Charles Clarke
Charles C. Gay

James L. Saunders
John W. Rice
John Dove
Thomas Pulling
Francis Ratcliff
Robert A. Hill
Michael Baldwin
Robert Titus
Robert K. Dabney
Francis V. Sutton
Joseph M. Shepherd
James Gibb
Thomas Butler
Charles Williams
Matthew C. Lachland
S. Y. Chandler
Turner Christian
John T. Pleasants
James Jackson, junr.
William W. Gray
Joseph F. Price
Robert W. Crump
William Hawkins
Susan H. Walker
William Ford

Henry County.

S. P. Stovall
W. Hereford
N. W. Dendridge
Joseph Martin
William Z. Mills
Thomas I. Wotton
Richard T. Boulden
Reuben Kington
John Dillard, junr.
William H. Wotten
Peter C. Cox
George S. Staples

Isle of Wight County.

Francis M. Boykin
John Hatton
Josiah Blount
Joseph W. Ballard
Edwin Delk
Henry W. Wills
Francis Wrenn
Henry Adkins
Meacham Fearn
Edmund Pedin
Dawson Delk
Joseph Chapman
Gideon Povell
Robert Laurence
James F. Copeland
William C. Conner
George Elliot Hines
Merit Jordan
Joseph B. Whitehead

Horatio Butt
James B. Wilson

James' City.

J. H. Ball
Robert G. Scott
I. W. Murdaugh
A. D. Galt
Samuel Travis
William M'Andlish
George Bray
Mary M. Peachy
Robert P. Waller
Richard Garrett
F. S. Barzezae
John Bracken
William T. Banks
John E. Brown
William Walker, junr.
James Semple
William Dennis
John B. Lee
George C. Dromgoole
John N. Stratton
Jesse Cole

King William County.

George Allen
James Edwards
J. B. Lipscomb
Corbin Braxton
Philip Aylett, junr.
John B. Richeson
James D. Chamberlay
William H. Moriss
William Burke
Sterling Ruffin
James Turner

King and Queen County.

Thomas C. Hooms
H. Gaines
Richard Collins
Thomas Faulkner
William Morris
John Fawcett
H. Newhall
William T. Evans
Thomas Collins, junr.
Archibald B. Harwood
John Boyd
Jacob D. Waker
John Richards, junr.
Zachary Levis
G. D. Shackelford
Francis Row
Thomas Hoskins
Hugh Campbell
Peter B. Davis
John Kidd
James G. Row
Philip Gatewood
George W. Gatewood
H. A. Brown
E. Uphon
Thomas F. Spencer
William Toad
George Wyatt
James Mitchell
Robert Pollard
William Semple
Christopher B. Fleet
John T. Carlton
William B. Westmore
Richard Taliaferro
Samuel May
Thomas Dix
Edward Willcox
Larkin Deshard

King George County.

George Johnson
Needham L. Washington
Jacob W. Stuart
George N. Grymes
T. Bernard
John B. Ashon
William Quesanburg
W. Beverly
Thomas Hungerford
Reuben Balthorp
Thornton N. Doniphan
George Chadwell
William D. Greer

Lancaster County.

Charles Taylor
Walter B. Waddy
Enoch George
George W. Dornman
John Sward
Cyrus Ball
John Lunsford
Charles J. Yerby
John Dogget
William Lunsford
Joseph B. Downman
William B. Mitchell
James K. Ball
Henry C. Lawson
John B. Downman
William Lee Ball
Bedhar George
F. Lemoine
John Chowning
Charles Carter

Lunenburg County.

Lyddall Bacon, junr.
T. N. Poultney
Richard Yarbrough
John I. Wells
James Neal
Joseph Degraphenreid
William L. Hite
Charles Bridie
George Craig
Benjamin Taylor

Louisa County.

William Meredith
Benjamin Willis
H. Lawrence
Bickerton Winston
Oliver Cross
William Morris, junr.
Joseph Sandidyr
Thomas Poindexter
William Mansfield
Thomas Gardner
Elisha Jackson
Thornton Gibson
Tarlton Henly
Andrew Kean
William Jackson, junr.
Henry Timberlake
James Miner
Pleasant Hatchhill
Ludlow Bramham
R. Terrell
Arthur Clayton
Ralph S. Dickenson
Manoah Lasley
Ralph Quarles
William Ragland
Nicholas T. Poindexter
G. M. Quarles
John Poindexter, junr.
David Watson
A. T. Goodwin
Garland Walton
Lundsford Lindsay

Loudon County.

P. Saunders
Robert Bentley
James Sinclair
R. H. Gover
George E. Cordell
William Shipley
William M. Turner
John Mines
S. Wherry
A. G. Munroe
James H. Hamilton
David P. Kline
Robert R. Huff
Tasher C. Quinlan
E. Offiutt

Samuel Buch
J. Rose
Samuel Carr
George M. Chichester
W. D. Drish
John A. Binns
George Head, junr.
Charles Douglass
John C. Quick
Britton Saunders
Sanford I. Rainy
Samuel Dawson
Francis Stribling
Archibald Maims
Charles B. Ball
Richard Williams
John Matthias
Philip Keatley
Stacy Taylor
James Allen
James Keaton
William H. Handy
Thomas Atwell
Samuel Clapham
Mahlon Janney
Edward B. Grady
Francis W. Luchett
A. Gibson
John Upp
Thomas P. Hereford
John White
Levis Elzey
Jonathan Heaton
Richard Norwood
David Copeland
Joseph Myers
Samuel B. T. Caldwell
Matthew Mitchell
Thomas P. Knox

Middlesex County.

John Chovning, junr.
Christopher Owen
Henry Muse, junr.
George Healy
Richard M. Segar
Samuel W. Sayre
James Chovning
George M. M'Intire
Anthony New, junr.
Elliott Muse
George D. Nicholson
Carter Perkins
Walter Healy
Warner Roane
Jeremiah Jackson
James H. T. Lorimer
Samuel Blake
Matthew Major
Thomas Blake
Meacham Owen

William Jesse
Thomas Healy
J. R. Stepton
Robert Blakey
William V. Montague

Matthews County.

James H. Roy
Richard C. Jones
Thomas R. Yeatman
Thomas Ransom, junr.
John C. Booker
Edmund N. Sale

Mechlenburg County.

David E. Jiggetts
William R. Bosherrill
William R. B. Clements
William Jones
Alexander Boyd
Edward L. Tabb
William Redd
Mark Alexander
Christopher Haskins
Robert Jones
Joseph N. Meredith
Abraham Green
William Hicks
John G. Baptist
D. Middaugh
John Barron
John Griffin
William Baptist
Samuel A. Douglass
R. D. H. Walker
Michael Tarwater
Green Blanton
Samuel L. Lochett
William Townes
Alexander Boyd

Madison County.

Richard H. Field
Larkin Harvey
Thornton Fry
Robert G. Willis
John Wright
Churchill Gibbs
Zachariah Shirley
George Nicholl
Reuben M. Strothie
Reuben S. Field
John R. Bohanan
James Clark
Robert Thomas
Thomas Clow
Thomas P. Simmons
Paschal Early
Henry Allison

Michael Wallace
Joel S. Graves
Benjamin Burton

Nelson County.

Robert Philips
Robert I. Kincaid
Spottswood Garland
James Garland, junr.
James Loving, junr.
Henry Rives
Nelson C. Clarkson
James P. Garland
John T. Dawson
Elisha Rider
S. Claiborne
James S. Penn
Thomas W. Coleman
William Murrith
William H. Shelton
James Murphy
James Spencer
Jack Nevil
Lem. & James Stephens
John Whitehead
Joseph Staples
John W. Green

Nansemond County.

Joseph Holliday
Stephen T. Hoortly
William Minton
Edward Brown
John Minton
Edward Wright
James Wilkinson
E. K. Brown
John Brewer
Jesse Holland
Edmund T. Goodwin
Jethro Powell
Edward R. Hunter
Benjamin B. Baker
Samuel Brown
Thomas E. Gray
David Parker
Wiley Parker
Andrew Ballard
Thomas Bevin
Wiley W. Parker
Benjamin Copeland
William P. Merritrue
Thomas Smith
Putmon Dickenson
John G. Prenner
William Reddick
Henry Gorham
John Murphy
Thomas R. Day

Luther H. Read
James G. Green
John T. Kibby
Jeremiah Goodwin
Josiah Reddick, sen.
John Murdaugh
John C. Cahoon, sen.
James Evans
Mills Reddick
Robert W. Jordan
Arthur Smith
Trejah Simmons
Matthias Jones
John C. Montgomery
Samuel Cross
John King

Notaway County.

William Pincham
Daniel T. Beasley
Edmond Wells
Peyton Doswell
John Hurst
Truman Fitzgerald
Thomas R. Eppes
William Gooch
N. Ward
Archibald Butler
Gideon Foster
Sygnal Moore
Edmund Irby

New Kent County.

John B. Clopton
John Vaiden
William B. Bailey
J. Ratcliff
Walde Clopton
Thomas H. Terrell
James H. Wilkinson
Robert Christian, jun.
Robert Perkins
John P. Poindexter
Henry Parham
Archibald Lacy
B. Dandridge
George P. Crump
William B. Amens
William D. Abbott
Hammermond Crump
Beverly Crump
Parks Hill
Thomas Claiborne
Abner Harmond
Robert M. Crump
Fielding M. Crump
John A. & William Taylor
William M. Massie
Carrell F. Chappell
Micajah Vaiden

Robert Bradenham
William Claiborne

Norfolk County.

John Owen
Thomas Morse
George D. Wise
George Webb
E. D. Wilson
William W. Cowper
John J. Campbell
Lewis Decimes
William Kean
J. G. Wilkinson

Northumberland County.

Thomas Brown
J. Ball, jun.
Pemberton Clayton
Joseph Baysye
James Smith
Thomas Hughlett
Baldwin M. Leland
Iza Anderson
John Gunstead
William Jett
Thomas Towles
John Chinn
John H. Fallin
William Nutt
William Harding
John Hughlett
Griffin H. Foushee
Charles Betts
Willis W. Hudnall
John M'Adam

Orange County.

Thomas Lovell
Ambrose Macon
Nathaniel Gordon
William L. Harris
Augustine Webbs
Blackwell Chilton
Reuben T. Clark
William S. Cowherd
Richard Carr
Joel W. Brown
Payton Grimes
James Coleman
Henry White
B. Brown, jun.
William Emmison
James Blackley

Powhatan County.

Edward Cox, jun.
Lilt. H. Moseby

John Randolph
William A. Cocke
Anthony M. Dupay
William T. Harris
Joseph Woodson
Jefferson Swann
William C. Netherland
William B. Taylor
Francis Watkins
Thomas Gordon
William W. Atkinson
Edward C. Swann
Charles Taylor
William H. Wash
William Andrews
Blagrove Taylor
Josiah Smith
Claiborne Watkins
Matthew Baker,
Richard A. Saunders
William Walthall
Edward Cox
Robert W. Mosby
Francis S. Sampson
Baylor Temple
Benjamin P. Howard
Jacob Meacham
William S. Dana
Francis S. O. Reilly
William Walker
Archibald Robertson
Parham Booker
Jacob Micox

Prince Edward County.

Simon Hughs
James I. Foster
Joel W. Jones
William B. Smith
John P. Smith
Joseph Woodson, jun.
John G. Sadler
Paul C. Venable
John M'Gehee, jun.
John Rice
William Matthews
Martin Hawkins
Nathan Greene
James R. Allen
E. Booker
Anderson Britton
William Scay
Henry E. Watkins
Peter Hales
Clement Read, jun.
William Bedford
Moses Tredway
John Silliman
Charles Woodron
Robert Venable
James Whary

James M'Dearmon
William Andrews

Pittsylvania County.

Ralph Smith, jun.
Vincent Witcher
Nathaniel Kirby
George Barges
William Estes
Robert Ross
John Harrison
John W. Paxton
Ransome Jeter
John Daniel
Thomas Stewart
George W. Ruger
James Garland
Samuel Garland
George Townes
William Leftwick
John A. Simms
Thomas G. Tunstall
Robert Wilson
Azariah Moore
W. A. Townes
Walter Cowles
John W. Thomas
Jeduthan Carter, jun.
Robert A. Ward
William Buford
S. T. Foster
David H. Clark
Robert Hainton
John Ware
William Adams
John Smith, jun.
Ichabod Thomas
Eustace Hunt
Selby Benson
Abraham Shelton

Patrick County.

Abraham Staples
Clark Penn
M. Sandifer
Thomas Penn
Jerman Baker
Lewis Pedego
Greenville Penn
Hardin Harston
John Hughes
William Carter, jun.
William Lyon
Brett Stovall
Madison Hughes

Prince George County.

John Battle, jun.
Edmund Harrison
Henry Heath
Lem. Honnecut
William Buckly
P. Andrews
Thomas Daniel
John H. Peterson
Josiah M. Jordan
Edward Banch
George P. Cooper
William Mattox
Lewis Batt
John S. P. Eppes

Prince William County.

Philip Klepstone
James C. Ducale
Alexander Turner
Zebulon Kankey
Gerard Alexander

Richmond County.

M. Saunders
Samuel Williams
William W. Forester
William Settle
John C. Peck
Vincent Bramham
John W. Belfield
William L. Lee
John N. Rootles
Robert W. M'Carty
William R. Jeffrys
William Saunders
W. B. Tomlin
Landon Carter
Richard Barnes
Martin Sesson
George Saunders
William Young Stierman

Rockbridge County.

William Caruthers
Charles P. Dornman
Augustus D. Lowry
Madison Caruthers
John Gibson
Bennet Hutchinson
George B. Nicholson
Samuel Smith

Southampton County.

Boling H. Barnes
Henry Briggs
Henry Gurley
John Thomas
William Bailey
Green Adams
James Britt
Simon Baylin
William I. Cocke
Absalom P. Smith
James Trezvant
Jordan Wornwell
Kinchen Jelks
Spratley Williams
Edward Ruse
Peter P. Wyche
John H. Chapman
Robert Rochelle
William B. Goodwin
James Myrick
A. P. Pecte
Alfred Simmons
Nicholas L. Williams
Richard H. Simmons
Thomas R. Collins
Gideon Bell
John Urqhart
John Crutchellon
Henry I. P. Westbrook
James Rochelle
I. Fort
Griffin Stith
Samuel Brown
William Ricks
David Newsum
James Jones
George Simmons
William L. Everitt
Francis Ridley
John Faircloth
Richard Blount

Sussex County.

William S. Parham
Ni Massenburg
David E. Mason
John Hall
Benjamin Pecte
Michael Bailey
John M. Jeffrys
William Thornton
John Nicholson
Henry I. Harrison
William Shands, jun.
John Parham
Thomas Blount, jun.
William E. B. Ruffin
William Adkins
Joseph Mason
John Lanier
Richard Eppes
Thomas H. Neves
Littleton Lanier
William Parham
John Key
John Moore
George Grave
Isaac Randal

James Dillard
Nathaniel D. Land
Augustus W. Haguist
Robert Pettiway
Peter Booth
John Huson
John Parr
Thomas Southall
Thomas Northrop, jun.
John E. Williamson

Surry County.

Walter Spratley, jun.
Peter T. Spratley
William Randolph
William Binns
Lewis M. Spratley
Thomas W. Bayr
William Scammell
William Carter
R. H. Cocke
Irby Jones
Willey Davis
Alfred S. Bailey
Thomas Clinch
John Peter
Benjamin Cocke
John Willison
Colin Bishop
Jonathan Ellis
John Faulcon

Spottsylvania County.

C. Gregory
William M'Farlane
Thomas G. Hull
E. Head
Sandford Chancellor
William Wright
Thomas Y. Smith
George Ellis
William D. Payne
John E. Blackwell
Thornel Twyman

Westmoreland County.

John W. Jones
John Harvey
N. V. Clopton
John Campbell
Joseph Fox
John M. Hungerford
Bobert Baily
William M. Walker
Henry Parker
William B. Smith
John Payne
William Middleton
Christopher I. Collins

Daniel Carmichael
Raldwin M. Lee
Samuel Templeman
James Jett
William S. Jett, jun.
Peter P. Cox

York County.

Joseph Monett
Frederick B. Power
Henry H. Shield
Christopher Hubbard
Kemp. P Elliott
Matthew Wells
Robert Shield
John Stedman
Thomas Nelson, jun.
Benjamin Waller, jun.
William Whittaker
Peter Manson
Lewis S. Charles
Wm. Patrick
Servant Jones

NORTH CAROLINA.

Beaufort County.

James Blount
Joseph K. Williams
J. E. Robason
William Holmes
Edward Quinn
H. C. Simmon
Thomas Ellison
Samuel C. Pate
Christian Mallison
Josiah Tripp
Jesse Godley
P. W. Camprerio
Thomas A. Carbarrus
Isaiah Woodward
William Worsley
Robert G. Green

Bertie County.

Edward C. Outlaw
David Goodman
Jonathan H. Jacocks
E. A. Rhodes
Robert C. Watson
Thomas Burchell
Benjamin Jones
Baldy Ashburn
Richard Poindexter
Joseph S. Pugh
Anthony W. Putney
George L. Ryan
Wm. S. Rhodes

Russell Minor
Edmund Fleetwood
Stephen Murdaugh
P. B. Martin
William Mais, jun.
Thomas H. Norfeit
L. Raby
William Lee Gray
William H. Green
Hum Lawrence
Stanby Hetrill
John Webb
Robert Peterson
Malachi Weston
Thomas Bond
William Spackman
James Palmer
William Lancaster

Burke County.

Milton Ladd
William Dickenson

Currituc County.

David Jones
Samuel Ferebee
Keeder S. Marchant
John S. Hampton
Jeremiah Land
Caleb Etherige
W. T. Barnard
Wm. Matthias
Isaac Baxter
John Lamb
Malachi Jones
Thomas Sanderson
John Shifop
Edmund S. Lindsey
Thomas C. Ferebee
Edward Hardey
C. Bell
Dennis Dozier, jun.
Samuel Salyear, jun.
John Mackie
Thomas Luffman
Samuel Williams
Lem. C. Moore
J. Baxter, for H. Bell

Camden County.

D. S. Burgess
Edwin White
Mason Culpepper
Ezekiel Trotman
Willie M'Pherson
Isaac Sellett
Malachi Sawyer
Willis Wilson
Thomas Roberts

Thomas Etheridge
Yellis Mandeville
Caleb Perkins
William Seirrange
Thomas Owen

Chowan County.

Alfred M'Gatlin
John Skinner
Charles E. Johnson
William Saunders
James K. Bent
James Sutton
Richard H. Blount
Thomas Vail
William Hoskins
Abraham Howell

Chatham County.

Edward Jones
Greene Warmack
William Scurlock
William Stedman
Bartholomew L. Hayes
W. L. Hayes
Joseph Schulock
Horace D. Bridges
John P. Smith
Ceorge Luther
James H. Rogers
George Gee
William Prince
James Taylor
Benjamin Brantley
James Massey
William Brinkley
Thomas Ragland
Zachariah Harman
Abner Brooks
W. E. Sledman
Murdock M'Kenzie
Charles S. Williams
William Norwood
Elijah Fooshee

Carterett County.

John Roberts
Andrew Wilson, jun.
R. H. Jones
James M'Cullough
Morais Hatchell
James W. Hunt
Andrew Wilson, for Nathaniel Pinchasn
David Hillan
Wilson Bugess Straits
John L. Hellen
John R. C. Jackson
Solomon Key

Caswell County.

James Rainey
William Rainey
A. & L. Graves
William Timberlake
John C. Rogers
Bedford Brown
John Stamps
Barz. Graves
Thomas Jeffreys
George Williamson
Ruffin Pleasant
Nathaniel Gooch
Griffin Gunn
Henry M. Clay
Solomon Graves
William P. Payne
John Moreton
William Graves
William Led
William Mitchell, jun.
James Yancey
James Scott
Henry Cobb
Quinton Anderson
Thomas Williamson
John H. Brown
Gen. Az. Graves
Romulus A. Saunders
Alexander Murphy
John G. Wilson
Gabl. B. Lee
Nicholas Thomson
John H. M'Neill
Richard Ofibby
Samuel H. Smith
Solomon Deboul
Richard H. Hayes
William Irvine
John W. Glenn
Thomas Turner
Ambrose K. Ramsey
Mason Graves

Cabards County.

N. Alexander
Charles Harris
Thomas Dennis
John Travis
John Locke
David Houlton
John N. Fifer
Abraham C. M'Ree
William Houston
John Moss
Robert Kirkpatrick
William F. Alexander
George Phifer
John Stewall
R. W. Smith

Cumberland County.

B. W. Williams
John M'Load
William Graham
David Howell
John M'Phaul
Thomas Hearned
John Hodges
John C. Williams
Lawrence Wood
George Hearsey
Joshua Carman
John N. M'Rae
James M'Intyre
Francis W. Waldo
John Matthews
Henry Elliot
D. O. Chiltrue
Martin M'Pherson
Hugh Bethed
James Atkins
John H. Pierce
John Shaws
Alexander W. Quire
James Ogner
I. T. Cushing
Robert Strange
James S. Richardson
William Forbes
Madison Caruthers
James P. Wilson
John M'Intyre

Craven County.

Thomas Hubbard
Hardy B. Law
E. Pastures
Jonathan Price
Hardy L. Jones
I. & B. Turner
Lucas B. Heritager
John Dewey
Thomas W. Macken
David A. Murdock
Jarvis B. Buxton
Lucas Benners
Charles Churchill
John A. Greene
Edward Kinnicut
John Vail
William Davis
Thomas M. Parker
William S. Harvey
James R. Bryan
Clairborne Ivey
Elijah Scott
John S. Smith
John B. Dowson
William P. Biddle
Durant H. Lane

William S. Blackledge
John O. Freeman
Frederick I. Cox
Isa Lipsey

Duplin County.

Joseph Greene
Andrew M'Intyre
David Hooks
Thomas Rutledge
James Dickson
John Cooper
Alexander M'Gowan
Robert Middletown
Elias Faeson
Alfred Beach
Levi Borden
Daniel D. N. Kennan
Stephen Graham
Thomas Hill
Samuel Stamford
Timothy Murphy
William Pickett
Joseph Dickson
Joseph Gillespie
A. Maxwell
William Hurst
James Pearsall
Dickson Sloan
Hugh Maxwell
Thomas Moulton
Samuel Dunn
David Wright
Benjamin Hodges
M. Sykes
John Hunter

Edgecombe County.

I. R. Leigh
George E. Sprill
David Dancy
Francis L. Dancy
Thomas H. Hall
John H. Parker
John W. Mayou
Daniel Redmond
Selah Hammond
James Bilbry
James S. Battle
Jesse Andrews
Jesse Battle
Frederick Philips
I. Benton
Arthur Bishop
Richard Harrison
John S. Rakestraw
George Brownrigg
Spencer L. Hart
Benjamin Weaver
William B. Ross
Kinchin Hines
Joseph Z. Dancy

Franklin County.

William Lancaster, jun.
Wood Tucker
W. H. Strother
Robert A. Taylor
Richard H. Fenner
John C. Perry
James N. Hill
Benjamin Waddep
Henry Yarbsough
William Murphy
Robert H. Wynne
I. Hicks
James K. Goodloe
E. I. Ransone
James T. Hill
Alexander W. Pasham
W. Wynne
I. Solomon
W. D. Jones
Davis Bayart
R. Inge
John B. Babbett
W. Moore
John Haywood
Gideon Glen
Nathan Perry
Jordan Thomas
Gray Bridges
Wiley O. Davis
Simon Jeffries
Samuel Shoman
William Goodloe
John Perry
William Jeffreys
Nathaniel Thomas
K. Williams
Jones Cooke
Walter S. Ribbe
James Yardsough
Richard Fox
William Harrison
H. Greene
John D. Hawkins
Daniel Blue
James Harrison
John L. Southerland
Benjamin Hester
C. Brooks
F. W. Pugh
Edwin Paschal
Simon G. Jeffreys
Nelson Andrews
William B. Eaton
John S. Inge
Benjamin Waddy

Gates County.

Elisha H. Eure
John H. Edwards
W. C. Brooks
Charles Townsend
William M. Harvey
David E. Sumner
James Gregory
Jonathan Mitchell
John B. Walton
Lem. Reddick
Jo. Reddick
H. Ballard
Mills Reddick
W. W. Reddick
William Goodman
Henry Reddick
Joseph Freeman
William P. Jameson
Charles W. Harvey
Benjamin Sumner
John V. Sumner
Joseph Gordon

Granville County.

James G. Lamon
Joseph Boswell
Andrew Rhed
Stephen Snead
John Hare
Parker S. Stone
Thomas Booth
Woodson Daniel
Robert Taylor
James Richards
A. H. Banks
Howell Morse
Israel Hargrove
John Washington
Anderson Freeman
Thomas Cooke
Thomas B. Littlejohn
Stephen K. Snead
Nathaniel Robards
Thomas Hunt
Anson Mitchell
William H. Gillian
William Dickens
Thomas W. Holden
John Y. Young
Thomas I. Hicks
Henry Young
Josiah Holden
Joseph Ames
John P. Smith
Henry Graves
Thomas Webb
Richard Sneed
Alexander Smith
Hamilton Roe

Benjamin Bullock
John Manning

Guilford County.

William C. Chapman
Abraham Green
John G. Coe
George Swain
D. G. M. I. Osborn
Daniel Worth
Isaac Thornborough
Daniel Orrill
James Coffin
William Denton
Levin Charles
John Cunningham
James Dick
Donald Stewart
B. B. Trent
Henry Humphreys
William Stanly

Greene County.

William Holliday
Palmer Moseley
William D. Hart
Adam Tooley
Gathier Moye
Josiah Q. Garland
I. Speight
Henry Best
Shepherd & Wilcox
I. M. Patrick
H. T. G. Ruffin
James Eastwood
Fr. Dickson
Charles Edwards
Thomas Speight
Demsey Blake

Hertford County.

Jonathan O. Freeman
R. W. Wilson
John Wheeler
James Vishu
Moses Clements
Augustine Moore
Daniel Southall
Isaac A. Langdon
Elisha Hoston
Jasper Picket
Jonathan Jenkins
Thomas Wynne
G. M. Smith
Bridges A. Montgomery
James Reid
James Capland
Asa Pick
James S. Jones
James P. Carter
Benjamin Hill
Joel Rayner
Miles Jernegan
Watson Lewis
Boon Felton
Elisha Williams
Joseph F. Dickenson
Roswell Harrison
Edmund Freeman
Arthur Carr
Andrew Oliver
George Browning, jun.

Halifax County.

William H. Pope
Richard Eppes
William Divier
J. Liscomb
John Powell
Thomas R. Nevell
Robert Shepherd
Ladaman Shelton
James Grant
J. Matthews
John Tillery
Robert Finner, jun.
Cadwallader Jones
Tripp S. Brownlow
John H. Bailey
Sylvanus Bell
L. Wilcox
Benjamin Hill
John Bishop
Thomas Hudson
Robert W. Williams
Janad Weaver
J. Brickell
R. L. Marshal
William Lowry
H. P. Miliken
Thomas Onsby
Thomas Gary
S. Rutland
A. B. Whitiker
John Crowell
Henry Dawson
Marcus A. Harwell
J. C. Harrison
James Zollicoffer
R. Johnston
Richard C. Crowell
I. R. Liscomb
William Harwell
Abner Knight
Elias Fort
Thomas Nicholson
Richard H. Dicken
Henry Harris
Mark H. Petway
Henry H. Long
W. E. Webb
Joseph Lane
Joseph Cotton
Robert A. Jones
R. T. W. H. Perkins
John D. Powell
James Turner
Edward M. Lindsey
Elisha K. Eure
Edward Dromgoole, jun.
Henry C. Janes
John Wilkes

Jones County.

Enoch Foy
Alexander Sledge
Luther Syler
J. B. W. Smith
A. B. W. Simmons
Asa Smith
William Orme
Robert Dickson
Robert Kornegay
Thomas Simmons
Isa Lipsay
John Giles
Isaac Hathaway
James Mumford
James Shine
William Rhodes
James Roberts
Hascal F. Hatch
Lewis Whittey
Jacob Field, jun.
Lemuel Hatch
John Raine
Edmund Hatch, jun.
William B. Hatch

Johnson County.

Thomas S. K. Brown
Ray Helme
Edwin Smith
W. W. Bryan
W. W. Battle
Halsey Bryan
N. W. Bryan
Samuel Norsworthy
John Saunders, jun.
Reuben H. Johnson
John Leach
Larkin Smith
Neill Brice
Starling Johnson
S. G. Smith
Wm. Henry Guy
Henry Stephens
Needham G. Bryan
John Stephens
R. Saunders

W. N. White
I. Watson
I. Saunders

Iredell County.

Alexander Hogan
I. P. M'Kee
William Kirk
Thomas Allison
A. D. Kerr
Joseph Gay
Joseph Oliphant
William Feemster
Colin Campbell
William M'Clellen
Joseph Davidson
Peter Claywell
Jacob Kibler
Hugh Torrence
R. Johnson
James Stewart
Abner Caldwell & W. Sharp
Joseph N. Kilpatrick
Samuel King
Robert Carson
R. Simonton
Absalom Simonton
John N. Hart
Wm. M'Knight & A. Graham
Thomas Crawford
John Mushat
Charles D. Conner
James R. Nealy
James M'Kee
John Dickey
John Sumpter
Archibald Brady

Lenoir County.

Alexander Measley
James R. Croom
Robert W. Goodman
James Bright
Blake Little
Lewis Bryan
F. G. George
George P. Lovick
Simon Bright
Herren Hutchens
John Trill
Benjamin Caswell
Walter T. Allen
Thomas A. Phelps
R. G. Croom
Blount Coleman
Sutton Hardy
Isaac Tull
Thomas Coward
I. Leany
Henry Tull
Lewis Phillips
Thomas Campbell
Joshua Croom
James G. Herritage
John Williams
Nathan B. Bush
William Loftin
W. Hardy
Bookcajah Smith
Lewis Loftin
John Grady
Need. Whitfiel
Nathan B. Whitfiel

Lincoln County.

Robert L. Neagle
John Hyes
John B. Harry
James Bivings
John D. Graham
Gen. John Moore
John Lusk
Peter Hermond
Robert H. Burton
John Hoke
D. Ramsour
Jacob Horney
Peter Summay
David Rheinharst
Logan Hemerson
Anderson Hoyle
John Wilson
Andrew Harmon
Jacob Reinhardt
R. & T. Williamson
Matthias Barringer
Charles Bennet
Samuel Martin
Lawson Henderson
John Butts & W. Kline
A. Lawrence
Benjamin James
Jacob Snyder
Lightfoot Williams
George Summey
Henry Cursler
W. C. Sadler

Martin County.

Reuben Wilkes
John Wilkes
Henry B. Hunter
John Luten
Henry Wheatley
Joel & John G. Smithwick
Samuel Hyman
Benjamin F. Slade
Henry Slade
H. G. Williams
William R. Bennet
James Bell
John Phelps
Levi Yates
James Moore
E. Smithwicke
Willie Howard
Joseph R. Ballard
Pierce Whitley

Moore County.

Burnel Boyle
John B. Kelley
William Martin
Kenneth A. M'Iver
William Buice
Richard Street
Bryan Burrough
William Thomas England
Jacob Gastor
John Cameron
Benjamin Pierson
Duncan Mercheson
John M'Iver
Cors. Dowd
Nicholas Nall
Neil Buir

Mecklenburg County.

John Scott
Thomas Huson
Thomas B. Smith
William Davidson
Edwin J. Osborn
D. R. Dunlap
Samuel Henderson
Alexander Green
James Sproll
S. Lowrie
John Hendrick
Henry Foster
Samuel O. Caldwell
J. M'Knight, jun.
Isaac Green
Thomas G. Polk
John Irwin
Joseph Wilson
Joseph R. Darnell
Henry Conner, jun
William H. Wilson
John H. Orr
M. M'Leary
Wm. P. Springs
Benjamin W. Davidson
W. Smith
Alexander Long

S. R. W. Fox
Col. W. B. Porter
Elvird C. Wilson
James G. Torrence
John Gilmer
Bobert Porter

Northampton County.

Richard Crump
William I. Colvin
Roderick B. Gary
Tom Hughes
Carter Jones
Hardy Pritchard
John Sandifer
Thomas W. Jinkins
John Peele
Bryan Randolph
Allen Deberry
Cullen Mitchell
James Monroe Walker
John D. Ames
Charles Edwards
John M. Benford
Wm. Son Glover
William Gooseley
Edmund Turner, sen.
P. Brown
John E. Williamson
James H. Sowsby

Nash County.

W. W. Boddill
Lewis Brodie
Isham Daniel
Michael Collins
Arthur Whitehead
Thomas I. Armstrong
Joseph Arrington
Nathan Poddell
Marmaduke Mason
C. B. Atkinson
Jesse Thorp
Isaac Watkins
Lewis Hines
David Daniel
Samuel W. W. Vick
Exam Philips
John Arrington, 2d.
William Burt
P. L. Williams
Clairborne Mann
Joel Harris
John I. Short
Willie Bunn
Dolphin Anderson

Onslow County.

James Thompson
Lewis I. Oliver
Lemuel Doty
Edward Ward
Eli W. Ward
W. French
James M. Nixon
Reuben Ambrose
Jereme Topp
Purnell Marshall
David Ward
Lott Humphrey
W. Mitchell
Lewis Foy
Robert White
William Snead
John S. Willson
John Giles
James M'Cullough
Solomon Key

Orange County.

John Taylor, jun.
A. Alston
James Thomson
James Whittled
Abrm. B. Bruce
A. D. Murphey
John Scott
John A. Meebane
John M'Cawley
James Mebane
John Van Hook, jun.
John T. R. Forest
David Ray
William Kirkland
Wyatt Ballard
Wm. Montgomery, jun.
D. Davis
Child & Claney
Wm. Huntington
Edward Robeson
Josiah Turner
Francis Child
John Young
Benjamin Barnham
Wm. Whitted
Samuel Hogg
James Webb
William B. Panerson
James S. Smith
David Yarbrough
Joseph Caldwell, 2 copies.
Abner W. Clopton
William M. Green, and
Thomas H. Wright
G. E. Badger
Hemdon Harolson

Person County.

Wm. Jeffrys
Ira Lea
Benjamin Chambers
Wm. M'Kissack
John Douglass
Duncan Rose
Cary Williams
John Brodhead
Lawrence Van Hook
Robert Jones
C. Burnett
Nathaniel Norfleet
James M'Murrey
Isham Edwards
Richard Hallburton
William L. Parker
S. A. Gleam
Hemdon Haroldson, jun.
John M. M'Gehee
John Van Hook, jun.
Thomas Sneed
Jesse Evans
Lord Lord
Kendell Van Hook, jun.
S. M'Kissack
Patrick M. Glenn
Samuel Davy
Samuel Dickens
James Daniel
David Jeffreys
Carter Atkinson
B. Rogers
John W. Williams
L. Barney
Robert L. Ward
James Satterfield
Bradshu Fuller
Edward Mitchell
James Hannah
William Irvine
Joseph M. Daniel
Richard Atkinson
John Gainer
Thomas M'Geher
Joseph M'Geher
William M'Geher

Pasquotank County.

Leonard Martin
Thomas D. Martin
Thomas Owin
William S. Muse
H. P. Reading
W. Beckwith
John C. Chringhore
M. S. Lewis
Miers F. Truett
Wilson Sawyer
William Gregory
W. Albertson
Caleb B. Nash
Josiah F. Ranke
Stephen Charles

Ambrose Knox
Enoch Sawyer
Richard Muse
A. Albertson
William Tubbs
William T. Relfe
Thos. L. Shannonhouse
Ambrose N. Doughs
Thomas Jordon
Daniel Long
William Shaw
William Crutch
William Carter
John M'Donald
William C. Brooks
B. F. Pollack
John Pool, sen.
Edmund B. Harvey
Benjamin M. Jackson
Thomas Cammander
Joseph Parker
Charles Bailey
John Mullen
Frederick B. Sawyer
Thomas Bell

Perquimons County.

John F. Hodges
Joseph Sutton
James Whidbee
Edward Wood
Exum Newby, jun.
Joseph Moore
Will Blount
James Leigh
Jesse Standin
William Arrenton
Asa Rogerson
Josiah Samborne
William Jones
Robert Wheaton
Nathan Winslow
Francis Nixon
Jesse Fletcher
Josiah Townsend
Will Reed
William R. Sutton
Thos. Gramberg

Pitt County.

Lemuel C. Clark
Thomas Salter
David Smith
Joseph Blaunt
John Hardy
Benjamin Merrell
Demsey Blake
Simon Noble
Henry Smith
T. A. Blackwell
James C. Greene
William Pugh
David A. Smith
B. C. Dupree
Robert Williams
Benjamin Tison
Josiah Wooten
Ichobad Tison
Ivy Foreman
Oliver Prince
Richard E. Rivers
T. Blount
Hadrianus Van Nordan
Allen Cannon
B. M. Selby
Bryan Grimes
Charles Green

Rockingham County.

James Sharp
Alexander S. Martin
James Barnett
Nathaniel Scales
Nathaniel H. Henry
Charles Mills
William Wright
J. Campbell
John Wilson, jun.
John Watkins, jun.
John Odineal
Robert Cox
Thomas Hill
Doct. J. Phelps
Thos. R. Ruffin.

Rowan County.

David Mock
James Cornell
Robert Clark
Robert Horne
John Frost
H. M. Stokes
James L. Wiley
M. Chamberland
L. L. Ferrand
Jno. Fulton
John Campbell
Thomas M. Linston
James Gillespie
John Beard
Charles Fisher
Ro. Locke
John L. Henderson
John Giles
Thomas L. Cowan
John Murphey
Michael Brown
Ezra Alleming
Joseph Chambers, jun.
Thomas Holmes
J. Knider
Moses Locke
William Long, jun.
Wm. Jas. Lawson, and H. Alexander
Robert Strange
P. A. Smith
H. Chambers
Lewis Utzman
Daniel Orrill
Herndorn Horaldson, jun.

Stokes County.

N. Shober
John Clements
Anderson Bowman
Thomas Armstrong
Charles Banner
Joseph W. Winston
Archibald R. Ruffin
William Barr
William Boyles, jun.
Isaac N. Ladd
John Doub
John Consad
Edward Moore
I. S. Hunt
Lewis Plume
Matthew Detherage
Matthew R. Moore
Johnson Clements
John Hinlly
John Mastin
I. I. Smith
R. L. Winston
Isaac Dalton
Jonathan Dalton
John Harris
John Clemmons
Joseph V. Gregg
William Hughes
John Webb
Augustine C. Sheppherd
William G. Haynes
Solomon Spenhour
Thomas W. Marston
John Evens
James M'Pherson
John Butner
Alexander Moore
Isaac Nelson
James Patterson
P. Hairston
John G. Smith
Ezekiel Frost
Asa Folger
Joseph Kerner
Getliel Byhan
Daniel C. Walford
Eli Cook
William Willson

Surry County.

Nathan Chaffin
S. Graves, jun.
Lewis Williams
Gabriel Hanby
J. D. W. Lester
James Marstin
James Williams, jun.
Geo. Kembrough
Jonathan Dalton

Washington County.

Samuel Skinner
Thomas B. Houghton
Samuel L. Wiggins
John Salsbury
William Currell
Geo. Nichols
Abner Nash Vail
G. L. Stewert
Frances Ward
Joseph B. G. Roulhae
Levi Fagan
Charles Blount
Daniel Leggett
Asa Davenport
John Stubbs
Aaron Harrison
William L. Cheson
S. Walker
W. Woodly
D. Marriner

Warren County.

Seth Ward
John Brodie
Henry Fitts
William P. Little
William Pannell
Nathaniel M. Johnson
P. Hawkins
John M. Johnson
John D. Plunket
Geo. W. Freeman
Robert R. Johnson
Robert Freeman
Joseph Hawkins
Carter Nunnay
Anthony Davis
M. Duke Johnson
R. F. Check
David Dancey
Thomas Davis
Thomas T. Russell
William H. Bullock
D. B. Allen
Robert Park
Thomas Bragg
Raleigh Mysick
James Babbett
Edward Pattillo
W. B. Camp
W. Powell
Reps. Mabsey
William M. Powell
Joseph I. Hawkins
T. H. Mysick
J. W. Judkin
John T. Clanton
Benjamin Riggan
Solomon Greene
James Nicholson

Wayne County.

William W. Huntington
Thomas Tartt
Smith Hogan
Henry Brownrigg
T. Hurst
Richard Washington
Barnibas M'Kinny
John Everitt
Robert Fellow, jun.
Matthew Everitt
Benjamin Jernigan
Joseph Edwards
J. Langster
Charles Bass
Joshua Ammons
Ezekiel Slocumb
Thomas Kenneday
Thomas Cox
Needham Walters
Isaac Handy
Aaron F. Moses
Hilliary Hooks
John M'Kinny
Sampson Lane
David Thompson
John & David Wasden
Richard Caseaway
John P. Wilson
Philip Hooks
Lemuel Witfield

Wake County.

W. R. Henton
W. Henderson
Beverly Daniel
Samuet Gasland
William H. Fowler
A. S. H. Burgess
A. I. M'Kethan
Nathaniel H. Wills
Orran D. Lamon
Barwell Battle
John Bell
Burwell Simms
Kenneth Gillis
John Rhodes
Charles King
Fanning Jones
Samuel Alston
Johnson Busbee
James B. Hill
Wm. M'Cullers
John F. Pride
Alfred M'Daniel
S. Turner
George W. Grymes
David Crenshaw
G. H. Scott
S. W. & I. Scott
Willis Whitiker
J. Hinton, jun.
A. Alston
Major Samuel G. Briggs
Benjamin Joiner

SOUTH CAROLINA.

Abbeville District.

Henry F. Power
Thomas Branson
John M'Comb
James M'Crachan
James Spann
Walter O'Beekley
B. F. Whitner
Willis Bostwick
Lewis B. Holloway
Littleton Myrick
William Wilson
Charles C. Mayson
William H. Bostwick
John Talbert
I. M. Cowderry
John Marsh
Nathan Lipscomb
Jared C. Groce
Archy Mason
William Tinsby
Thomas Woolridge
John W. Wilson
Tal. Livingston
Alexander Speer
W. P. Rayford
E. S. Davis
William Robertson, jun.
Samuel Lenton, jun.
Moses Taggett
Joseph Pickens
Jefferson L. Edmonds
D. M'Gehee
Joseph Culpepper
Richard Covington
William Ware
Andrew Milligen
Edward Collier

William Benford
A. W. Scott
John Scuddy
Rev. Henry Reed
Thomas Childs
Thomas C. Oliver
Benjamin Glover
Thomas P. Martin
Moses Waddel
William Lomar
H. Miller
William Mountcastle
John Childs
Charles Martin
B. H. Savon
Alexander Bouie
Alexander B. Arnold
Patrick Calhoun
Joseph Miller
Jos. B. Gilbert
William Calhoun, jun.
William Lesley
James Collier
James Lomar, jun.
John Kavlin
Alexander Hunter
Abraham Landsdale
James Conn
Josiah Patterson, sen.
John Devlin
I. I. Ash
Robert Black
Randsome Warrell
James Cobb
G. W. Martin
Thomas Jones
Richard Griffin
William Wire
James Wilson
John Ellington
John M'Calla
John Bucanan
Edward Ware
Robert S. Jones
Gen. Joseph Hutton
William Spear, jun.
Hugh Morrah
Patrick Noble
James W. Cotton
Stephen Crenshaw
Marshall Wetherall
Thomas Sinsley
Henry Haston
Rev. Washington Belcher
Francis Connor
Wisley Brannan
William H. Glanton
James Campbell
John Montgomery
Hugh Mecklin
John Allen
Joseph Cooper
William A. Slaughter

Barnwell District.

J. R. Vince
Robert Lowry
Henry Burford
Thomas G. Lamor
William Gilliam
Henry W. Oakanan
John Richenbaker
Gideon Hagood
John I. Gray
James W. Tarrant
Robert Goode
Benjamin O. Dom
Isaac Bourdeaux
James R. Dopson
Joseph Eastland
Z. O. Bannon
Joseph Duncan
C. Tobin
John Miller
W. W. Dunn
John S. Fowke
William H. Robert
Isaac Easbank
I. W. Moore
Darling Peeples
Isaac Ellis
Wm. H. Lee
John C. Allen
Richard C. Ashe
John Owens
Benjamin Tarrant
William Black
Joseph Harley
Angus Patterson

Beaufort District.

John S. Smith
William Hazzard
John Ulmer
Charles I. Davis
Edward W. North
Abraham Huguenin
Henry M'Clish
Benjamin H. Buckner
Charles E. Flinn
B. Cooley
William I. Huguinan
Joseph Guerard, jun.
John Stone
Isaac Davis
Joseph I. Robert
John C. Cook
Thomas G. Cheney
William Taylor
John A. Cuthbert jun.
Charles G. Capers
Geo. I. Logan
R. Zubbolt
John D. Mangin
Col. Bailey
Myer Jacobs
John S. Maner
Samuel. M. Wallace
Philip Eastmead
Richard Bland
Alexander Hamill
Charles H. Collins
F. Bowler
Nathaniel H. Rhodes
James E. Flagg
James R. Verdier
Benjamin R. Bostwick
William P. Molett
Philip P. Bessellen
William Lake
Saul Solomon
Thomas L. Seawell
William Bell
John Fitzpatrick
Lewis Harden
William Chaplin
James L. Grayson
John Tripp, jun.
John M. Gilbert
Thomas I. Griffith
I. Lockwood
Stephen R. Procter
Thomas Wilson
G. B. Cheney
John Hogg, jun.

Chester District.

Daniel M'Neel
David Patton
John Dunnavant
Hanry Bradley
John E. Dunning
Solomon Beach
Samuel M'Neel
Gavin M'Millen
Wm. Stringfellow
Thomas Brown
John Boyd
William Harden
Robert Robertson
Aaron F. Quay
Robert F. Lyme
John Kidd
Thomas G. Blewett
S. Beekman, jun.
Allen Knight
William M'Aulla
Andrew Park
John Wylee
R. W. Gill
Joseph P. Lewis
Hugh M'Millin
E. Lyles

John Roseborough
Alexander Cabear
John Darley
Thomas Davis
James Adam
Stephen Ferry
John W. Ferry
Samuel Johnson, jun.
Daniel M'Millen
James Hood
Hugh Knox
William Leach

Darlington District.

Joseph Woods
Gad. M'Farlane
Thomas Smith
L. Hanmer
John D. Witherspoon
William Cooper
E. H. Lide
B. L. Hannac
Hugh Thompson

Edgefield District.

Alexander S. Moore
William Brazier
Martin & Williamson
John Torrence
Sterling Quarles
Seaborn Thorn
Benjamin Frazier
John Moore
John Middleton
Jesse Simpkins & Co.
Charles Hammond
George Butler
Thomas Websters
Charles Lamar
William W. Fell
Charles F. Randolph
Joel Hill
William Garrett
George M'Duffie
John S. Jeter
Stephen Garrett
Charles Bussey
Sampson Butler
Charles Goodwin
John R. Bartie
Isaac Randolph
Thomas A. Cotton
W. S. Johnson
John Blocker
Jesse Blocker
George Graves
John Miller
Edmund Bacon
Samuel Marsh
Wilson Wheatley

Fairfield District.

Robert L. Knox
Abraham Ferguson
T. H. Taylor
John D. Winn
Samuel Brown
William Holmes
John Workham
M. V. Davison
Samuel E. Arnatt
David Alston
William Wheeling
Hugh Young
S. W. Youngell
Elisha Jones
Marquis Calmes
Col. James Mooreman
Philip E. Pearson
Henry Rugely
John Douglass
N. O. Wade
William Thompson
Isaac Means
Caleb Clark
Samuel G. Barber
Thomas M'Cullough
William Ellison
Armisted Goss
Archibald Beaty
Hugh Smith, jun
C. Buchanon
William M'Bride
Patrick M'Guire
Asmund Woodward
Rabb & Woodward
James Kelly
Capt. Wm. M'Creight
James Guy
Austin F. Peay
John M'Master
Henry Moore
James Neily
John Allen
John Thompson
Burrel B. Cook
W. Atkinson
James Stevenson
Christopher Plunket
James M'Arnall
James Roochell
Thomas Starke
Reuben Veale

Greenville District.

Daniel H. Tillinghast
John B. Williams
Thomas Edmundson
Jeremiah Cleavland
Benjamin Kilgore
William Young
William Soney
Robert H. Briggs
William Halcombe
Spartan Goodlet
John Crettenden
Samuel Crayton
James Sheppard
Wm. D. Bradford
John Gowan
Richard Harrison
A. K. Parkins
Richard Ward, jun.
Allan Marshall
Andrew B. Flemming
Paschal Smithson
Gen. John Blassingame
John Moon
Samuel Sawney
John Paris
Garland Walker
Philip Masoney
Joseph Otis
William H. Cook
Thomas Payne
Benjamin Arnold
Thomas Hamilton
Nelson Dickeson
Daniel Rinhardt
Rev. Lewis Rector
Thomas West
William H. Salmon
Andrew M'Crary
Bannister Stone
Benajah Dunham
Tully Bolling
John S. B. Foster

Kershaw District.

Zach. Canten
S. H. Boykin
John Boykin, jun.
Alexander Young
S. Rochell
Ezekiel Mahew
David George
George Perry
Vincient A. Edwards
Lovich Youngs
Col. Adam M'Willers
M. C. Wiggins
Powell M'Red
James C. Irvin
Thomas English
James Surley & I. Jinkins
A. G. M'Kenzie
William Gibson, jun.
Abijah Miller
S. Rembert
John Carter
William Trapp

Lancaster District.

James Vaughan
Thomas Williams, jun.
John E. Sanderson
Francis K. Brummett
William M'Kennd
P. W. Flynn
Parmenio Rodgers
William R. Dickey
William E. Johnson
G. D. Wilfong
John M'Kinzie
E. F. Crocket
Samuel Sellers
James Witherspoon
John Gooch
Hugh Bird
John Crawford
John Hancock
William Bailey
Benjamin C. Jones
Buckner Lanair
John Montgomery
John Barkleip
Daniel H. Gantzon
C. Elms
James R. Massey
Benjamin S. Massey
James C. Massey
Isaac Donnon
James Crane
Thomas Graham
Robert Cunningham
Jehu Postell
John S. Perry
Allen Chevis
Robert D. Montgomery
Daniel M'Donald
William Howe
Thomas Lee
Henry M'Donald
John Brown
Eli Crocket
James Wright
Benjamin Massey
Robert A. Crocke
Zadock Perry
S. M. Adams
John L. Miller
Samuel R. Gibson

Lexington District.

John C. Bell
James Pou
David Sohrock
John F. Seibels
Jacob Ball
John Patton

Laurens District.

John Cunningham
Henry C. Young
Thomas Porter
S. B. Lewers
Richard F. Simpson
John Dunlap
J. H. Irby
Patillo Farron
William F. Downs
Nathaniel Day
Thomas F. Jones
Abner Crenshaw
William H. Young
Thomas Wright
Anthony F. Golding
Willis Hogg
Hezekiah Cheshire
William G. Wright
S. Richardson
W. W. Simpson
Mitchell Cook
James Brewster
James Loughridge
C. Saxon
Robert Campbell
Benjamin James
Daniel Long

Marion District.

Henry Davis, jun.
Thomas Harllee
Duncan M'Rae
James C. Bellune
C. Daniel
T. Evans
John M'Millin
Robert Giles
William Woodbury
Richard Woodbury
Nimrod Davis
Hugh G. Godbold
H. M'Kay
James Johnson
R. Godfrey
Enos Tart
John M'Lean
Neel Hughes
Dougall Carmichael, jun.
Samuel Bigham
Hugh Hodges
L. Harrell
Francis A. Wayne
John C. Davis
William Cox
John Gregg
John C. Godbold
W. G. Singletary
Elisha Bethell
Robert J. Walsh
D. Stone
John N. M'Rae
Stephen Thompson
John Newsom
Edward Birch
J. Gibson

Newberry District.

William Caldwell
Francis B. Wiggins
James Rogers
Y. I. Harrington
Robert R. Nance
William Rutherford
Andrew Cromer, jun.
James Fernandes
Burr Johnson
Burt Harrington
James Schell
David Gunn
Joshua Wynn
J. B. O'Neal
James Gilliam
A. Atkins & T. S. Barrett
Thomas Pratt
John Eigleberger, jun.
John Clemens
Thomas E. Burnsides
James M'Gight
John Barrskett
A. Crenshaw
A. G. Smith
Andrew M'Bride
Geo. W. Glenn
James Caldwell
H. Ruff
Peter Moon

Orangeburgh District.

M. O. L. Thompson
W. J. Myddletown
John M. Felder
Donald B. Jones
James B. Bowdoin
David Rumph
J. Rumph
V. D. S. Jameson
Daniel Frederick
Andrew Heatley
Jacob Wannamaker
Berther A. Downes
Donald Rome
Samuel Reckenbaker

Pendleton District.

William Trimnier
Rev. Richard B. Carter
James Thompson
Joseph V. Shanklin
Samuel Cherry
William Hunter
C. B. Benson

Joseph B. Earle
John Martin
W. S. Adair
J. Miller
David Cherry
Joseph Greesham
John Greesham
Jesse P. Lewis
John B. Hammond
James Fares
A. Lorn
Wm. Anderson
John Arraib
John Hunter
Samuel Earle
Joseph Whitner
John Maxwell
Robert Stribbling
Patrick Norris
John Matthews
D. Sloan, jun.
Rev. James Hillhouse
Nathaniel Harbin
Richard Barry
James Lawrence
Crosby W. Miller
Arnsted Barry
Reuben Piles
John Brown
Harrison & Earle
John Harris
Robert Wilson
John Clayton
John Nichols
Nathl. Harbier
John T. Niel
Aaron Broyles
Benjamin Duprie
Andrew Ramsey
William Walker
John Brown
John Archer
E. M. Massey
H. Kilpatrick
James Oliver
John Verner
Joseph Taylor
Abner A. Steele
Henry W. Terrell
William May
David Moseley
John S. Bowen
John Whitten
William Nicholson
Robert Brackenridge
John N. Montague
Wm. Simpson
David Pugh
Benjamin F. Sloane
Robert Hackett
W. Taylor
John T. Lewis
R. Spriggs
James Gerven
Thomas Fitzarrelled
C. Gaylord
Peter Kilpatrick
Walter Adair
William Carson
Thomas Hunter
W. Steele
Robert Fullerton
Thomas Harrison
James C. Griffin
Lewis Rolston
J. Brewster
John M'Hall
Wm. C. Baskin
James Jolly
Geo. C. W. Foster
John Reeder
William Salsbury
Robert Anderson
John B. Earle

Richland District.

Abraham Nott
John Withens, jun.
David H. Means
Melach Howell
Thomas Briggs
William Rivers
William Hilliard
John Veal
James S. Goodwin
Robert Ogilvie
C. C. Williamson
Wm. W. Adam
W. Howell
W. T. Pearson
James Gingrard
B. F. Taylor
John G. Brown
John Byrram
John Yancey
David Myers
Robert Singleton
Josiah Kilgore
John Hopkins
H. P. Taylor
J. Howell
D. Coalter
S. Jones
Needham Dudley
Osmond Ross
Anthony Metcalf
William Surginer

Spartanburg District.

William Hunt
S. Foster
Laban P. Poole
Munn Tallison
Eben Smith
Thomas Allison
Elisha Bonar
Michael Gaffeny
Arthur Clark
Bennett Bobo
Andrew B. Moore
Lawson Thomson
Isaac Smith
J. Whitten
Benjamin Warford
William Collin
Robert Martin
John Chapman
E. Roddy
Chany Stone

Sumpter District.

Horace Ward
I. I. Frierson
Chas. Richardson
John S. Willett
Charles Miller
Daniel Rose
Charles Conners
A. P. Johnson
Christopher M'Connico
James N. Mayrant
James Haynsworth
John W. Rees
Robert Brailsford
Charles Harvin
William Falconer
Samuel W. Cummings
Henry Spears
Geo. I. M'Cauley
Thomas Bosher
Hastin Jennings
William Coppidge
W. R. Thomas
William Taylor
John B. Miller
Robert Bradford
Stephen D. Miller
W. Vaughan
Thomas James Wilder
Milton Bradley
Daniel Loring
John Jennings
Amos Dubose
Wade H. Gaulden
John G. Davis
Thomas Davis
William G. Richardson
James R. Center
Reuben Arthur
Caleb Rembert
Peter I. Wright
Stephen Dyson
Wm. V. Richbourg

Robert Mularon
Richard Redgeville, and Charles Brunson
James E. Harvin
Thomas G. Polk
William Ballard
William M. Lansdell
Holloway James
William Alex. Colclough
J. J. Evans
James G. Spann
Thomas Dugan, jun.
Joseph West
Francis Spring
John Boyd, jun.
Samuel Bennett
Matthew S. Moore
William Potts, sen.
W. H. Capers
Philip Bracy
James Millett
Israel Whipple
James Barrister
John Cox
John G. Moore
Thomas Ebzbirgh
Edward Broughton
John M'Donell
John King
Peter Millett
A. B. Drake
William Bell
Spencer Wilder
A. Silliman
William Haynsworth
John Mayrant, jun.
Christopher Flynn
James Capers
Thomas Rivers
John Mayrant, sen.
Samuel Wright
Geo. W. Pitts
B. Gerald
Jno. Waters
A. Sexton
Isaac Hinkle
William Mayrant, jun.
John Dorgan
Charles F. Gordon
Rev. John Conser
Arthur Bradley
John Bradley
David Brunson
R. Mularow

Union District.

Daniel M'Mahan
Francis Hobson
Nathaniel R. Eaves
Harman A. Johnson
Banks Meacham
Daniel Wilbanks
Joseph Reid
Charles Littlejohn
Thomas C. Taylor
Amos Davis
Philip Coleman
W. Hobson
W. R. Clowney
J. H. Bernard
William Wallace
J. F. Walker
Geo. M'Crary
John Hall
John Lusk
William Rice
Samuel Davis
W. Sims
James P. Walker
J. J. Foster
Andrew W. Thompson
John H. Ragsdale
William F. Gest.
D. I. Murrell
Jno. Morgan
James Bryce
J. M'Ribbin
James Black
James P. Ewing
John Carathers
R. S. Rice
David Johnson
Wm. P. Gadberry
W. Henderson
Wm. Kingsborough
Nicholass Corry
J. Collin
Wm. B. Means

Williamsburg District.

Thomas Witherspoon
William Dobard
James & Robert Bradley
Robert I. Willson
J. W. Witherspoon
T. D. Singleton, for Williamsburg Library Society.
Isaac A. Cohen
Thomas R. Witherspoon
J. W. Powers
Isaac Matthews
John D. Burgess
W. Salters
Wm. N. M'Donald
John S. Flurett
James E. Wilson
John Blakeley
Jno. Matthews, jun.
Jesse Du Bose

York District.

Robert Clendenan
David B. Rice
John Rochell
Wm. Moore
Benjamin Chambers
Daniel Kerr
John Gallent
William Campbell
John S. Moore
Edmund Jennings
Richard Sadler
John Davison
William Ferguson
John Dennis, jun.
William C. Hannd
Samuel B. Buyer
Geo. Ross
William Gillmore
William Little
Herman Alexander
William Moore
William Barron
Edward Avery
John Thompson
James M. Love
James Leach
Jesse Loughby
Samuel Ranney
John S. Britten
Wm. Robeson
Leven Benton
Francis M. Nash
John Bailey
Patrick Hamilton
John Caveny
A. M'Whorter
G. Galbraith
Moses Stroup
John S. Hartness
James Davie
I. Clendenen
James Williamson
James Lacy
Thomas Moore
Thomas M'Kee
Solomon Hill

Winsborough.

John Shackelford

Charleston.

Kerr Boyce

GEORGIA.

Augusta.

Edward F. Campbell
John Hart

John Black
Benjamin Hall
I. H. Randolph
Walter Crenshaw
John Bent
Luke Reed
John Burton
James Harrison
John Taylor
Jesse Ansley
John Logan
Edward Byrd
James House
Thomas Glasscock
Smith Jones
Nathaniel Truesdel
Thomas Averell
James Rose
Henry Slaughter
George W. Collins
John Rinney
Miles Beach
George K. Bridges
I. L. Laughria
James Violleau
Wm. Matheson
John S. Walker
Ethelred Langston
James Clark
Nathan H. Beal
Caroline I. Buckle
Jesse Whipple
James Stewart
Corby Dickinson
Adam & John Kerr
James M'Donough
John Pries
A. R. Ralston
Robert I. Sayn
John Duncan
Samuel Sturges, jun.
John Smith
Charles Labuzan
Charles H. Penn
George Hudson
John H. Kimbell
B. Labuzan
Augustus T. Hand
John Jones
R. V. Mayre
John R. Welborn
John B. Haw
Wm. Nevis, jun.
John M. Davinvort
Winfield Mason
Richard Mason
John Sharp
George Kennedy
Timothy Bruen
Wm. P. Dearmon
John Guimarin
A. Bugg
Charles Spear
B. Prigurs
P. Brown
E. Walton
Anderson Watkins
Wm. Montgomery
Robert Malone
Lewis Cooper
L. F. Barfield
Thomas Grace
F. H. Lacy
John Cashin
W. A. Bugg
Mark D. Clark
John Gindrab
Cain Broight
Edward B. Machen
John M'Mullen
Charles Dame
Ephraim Gilman
Richard Bolan
James Barton
Ezekiel Edans, jun.
Patrick M'Kee
Richardson O. Scarry
Peter Donaldson
George T. Watkins
John M. Eaney
Richard I. Easton
James A. Black
Robert Mitchell
Wm. C. Anderson
Robert H. Watkens
Ezekiel Dubois
Thomas G. Leigh
W. C. Stokes

AVES.

Plate XIV.

Fig. 1. Struthio *camelus: Black ostrich_ Fig. 2.* Tantalus *melanocephalus: Black headed ibis.*

Fig. 3. Trochilus *amethystinus: amethystine Humming-Bird. Fig. 4.* Upupa *magna: Grand hoopoe.*

Fig. 5. Vultur *papa: King Vulture.*

MAMMALIA.

Fig. 1. Sus *scrofa: wild boar. Fig. 2.* Ursus *arctos: black Bear.*

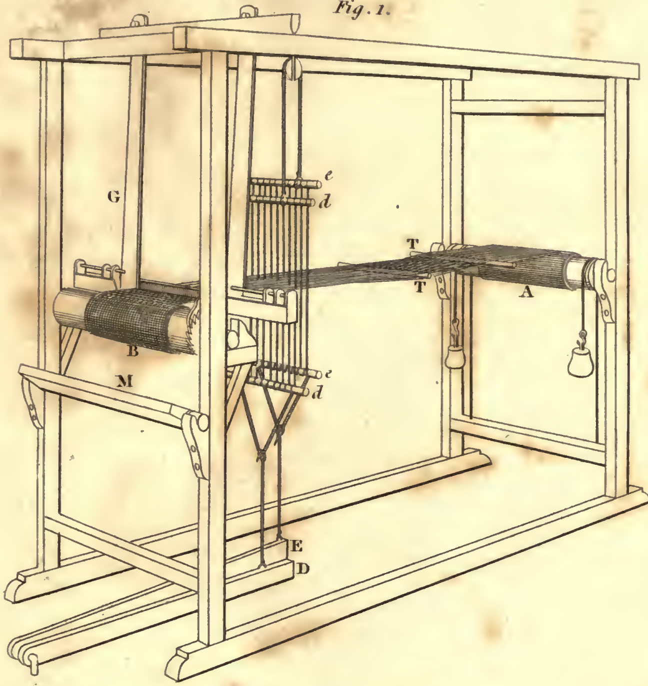
Fig. 3. White Bear. Fig. 4. Trichechus *dugong: Indian Walrus.*

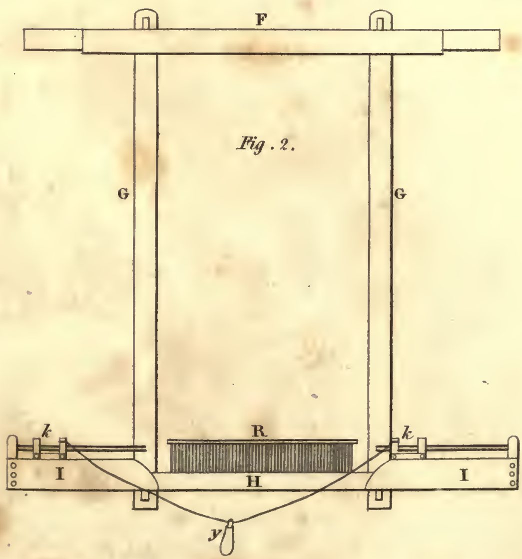
Fig.1. Phalenia *Junonia*_*Fig.2.* Phryganea *grandis*_*Fig.3.* Scarabeus *fullo*_*Fig.4.* S.Hercules_ *Fig.5.* Sirax *gigas*_*Fig.6.* Sphex *maculata*_*Fig.7.* Sphinx *atropos*_*Fig.8.* Thirps *physapus*_ *Fig.9.* Vespa *vulgaris.*

Fig.1. Squalus *cinereus: basking Shark_Fig.2.* Sternoptyx *diaphana: transparent sternoptyx.*
Fig.3. Sygnathus *foliatus: foliated-pipe fish_Fig.4.* Tetrodon *testudineus: tortoise shell tetrodon.*
Fig.5. Xiphias *gladius: common sword-fish_Fig.6.* Zeus *faber: common dory.*

LOOM

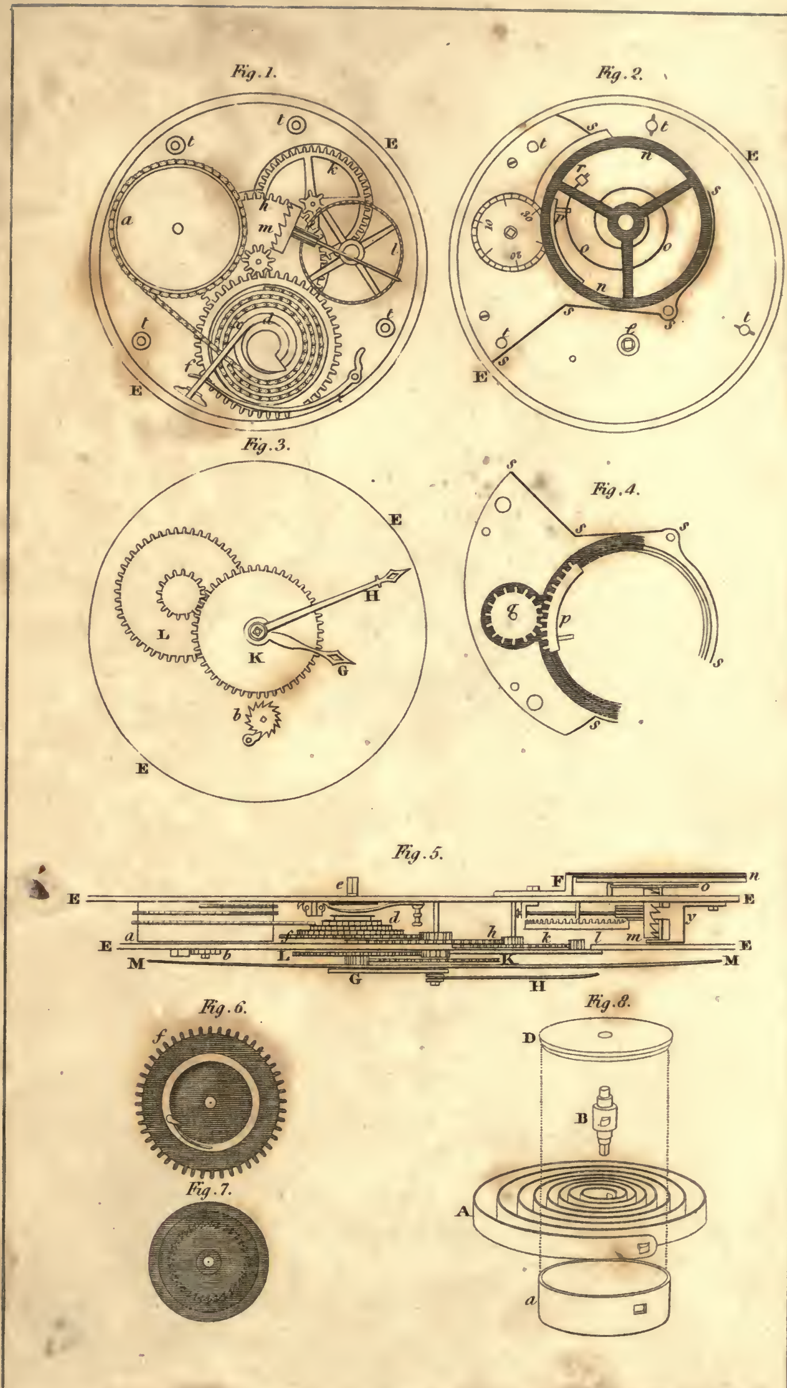
Fig. 1.



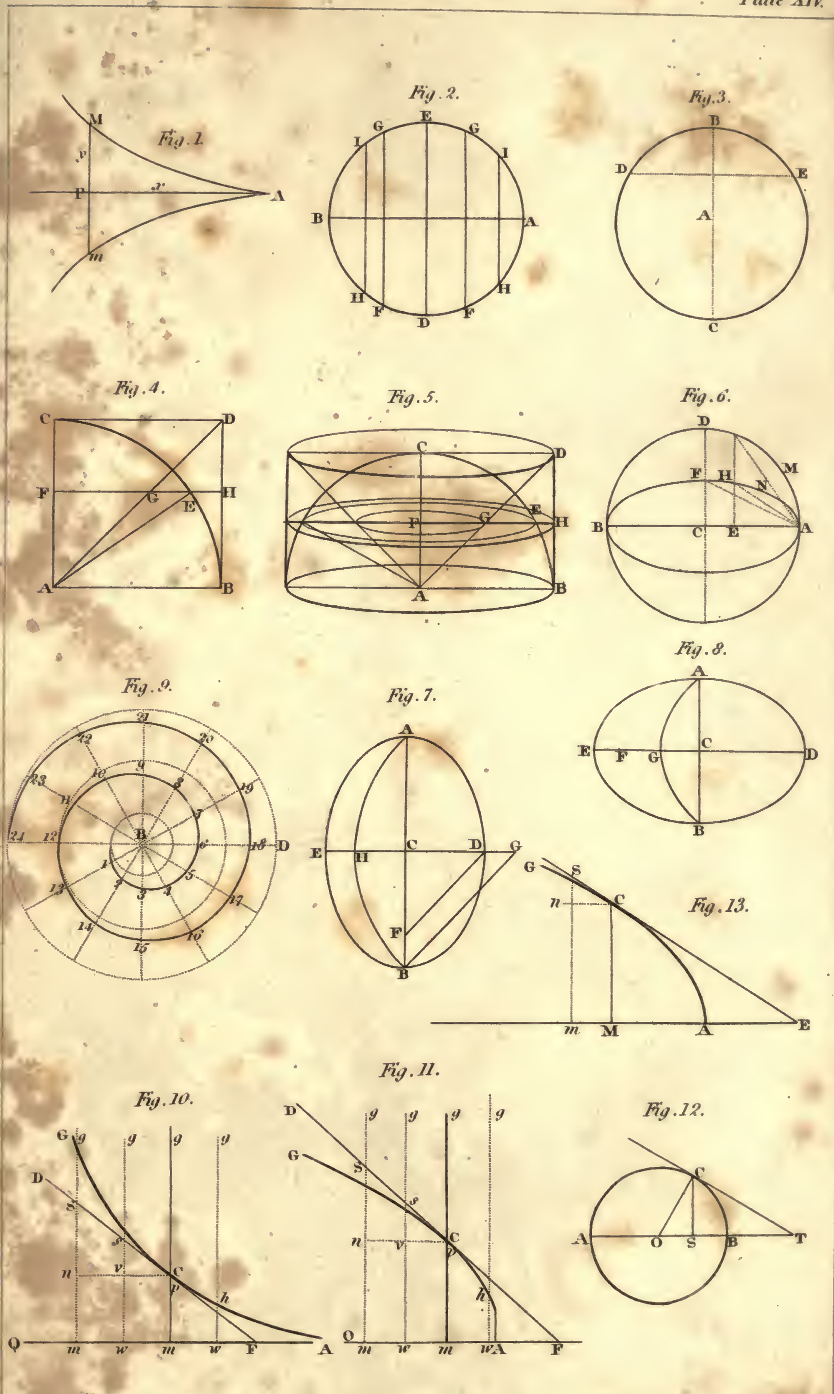


Kneass, Young, & Co. Sc.

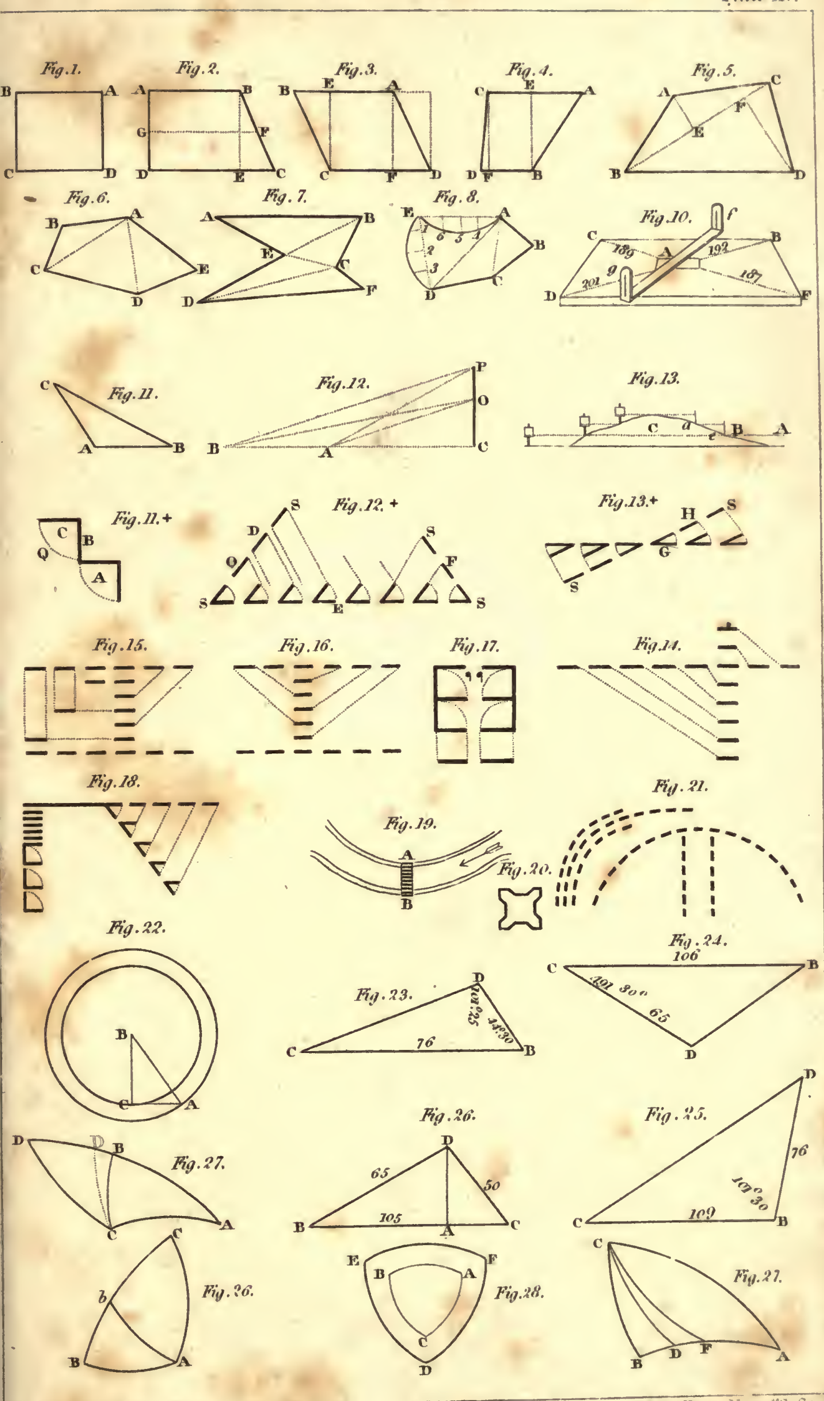
WATCH.



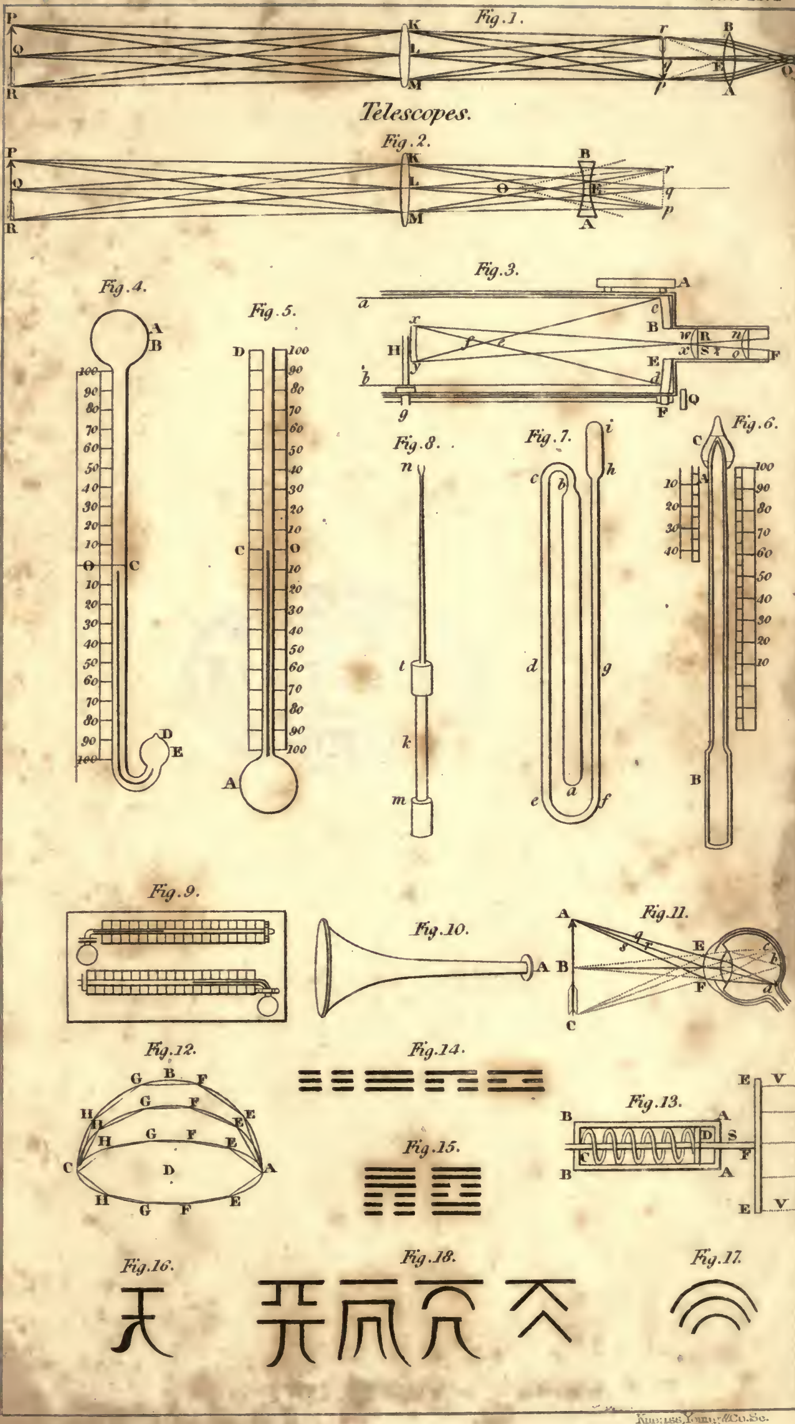
Kneass, Young & Co. Sc.



Kneass, Young & Co. Sc.



Kneass Young & Co. Sc.



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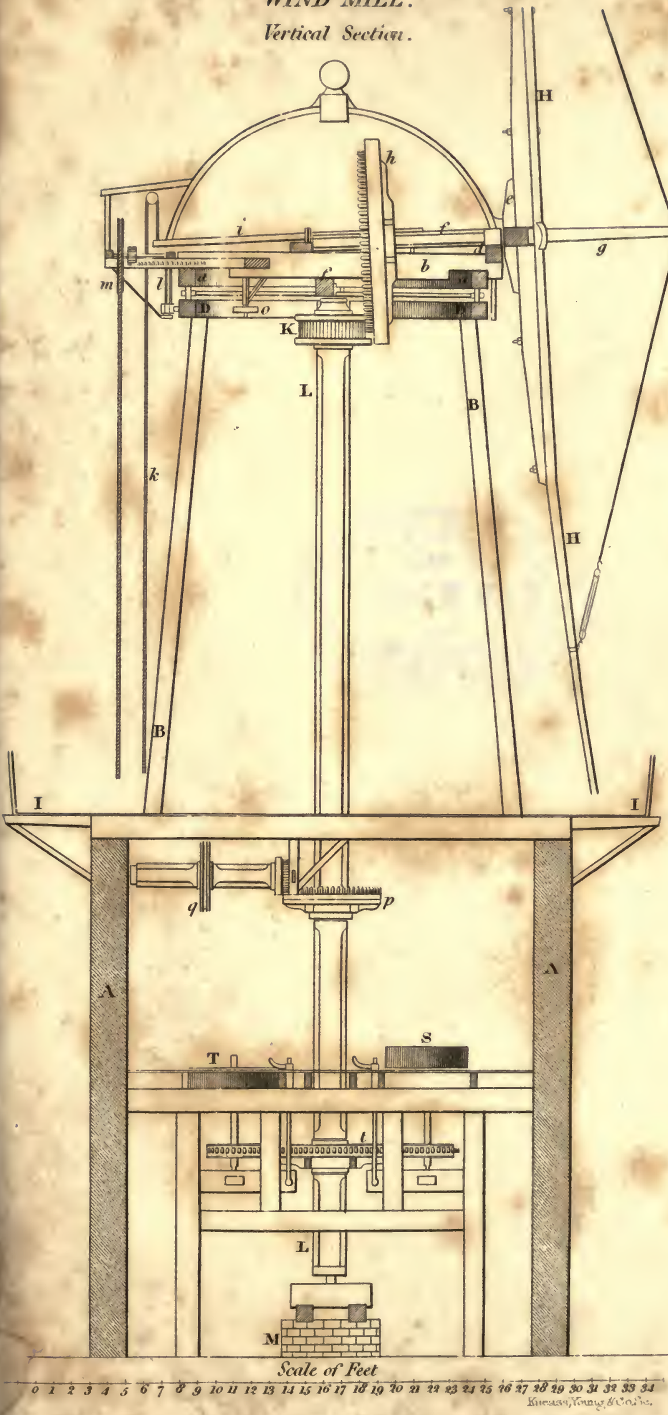
WIND MILL.

Vertical Section.



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